AF/2813
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IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Application of:
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Serial No.: 09/880,975

Filed: JUNE 13, 2001

For: METHOD AND APPARATUS FOR CONTROLLING A THICKNESS OF A COPPER FILM

Group Art Unit: 2813

Examiner: E. KIELIN

Conf. No.: 5882

Atty. Dkt.: 2000.045300/TT3258

CUSTOMER NO.: 23720

REPLY BRIEF

Request to Maintain Appeal In Response to Final Office Action Dated June 8, 2005

CERTIFICATE OF MAILING UNDER 37 C.F.R. § 1.8	
DATE OF DEPOSIT:	September 8, 2005
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Commissioner for Patents
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Alexandria, VA 22313-1450

Sir:

Appellants hereby submit this Reply Brief to the Board of Patent Appeals and Interferences in response to the Final Office Action dated June 8, 2005. Appellants hereby respond to the Final Office Action by reinstating the Appeal by filing this Reply Brief. All issues in the Final Office Action have been addressed in the Reply Brief.

Originally, a Notice of Appeal for the above-captioned application was filed on December 29, 2004 (in response to a Final Office Action dated October 25, 2004). Subsequently, an Appeal Brief was filed on February 28, 2005. The Examiner subsequently re-

opened prosecution in the Final Office Action dated June 8, 2005. The shortened, three-month statutory date for response to the Final Office Action dated June 8, 2005 is September 8, 2005. In response to the Final Office Action dated June 8, 2005, Appellants hereby exercise their option to Maintain Appeal and accordingly, request that the Appeal be reinstated and, therefore, are filing this Reply Brief. Therefore, this Reply Brief is believed to be timely filed. However, if an extension of time is required to enable this paper to be timely filed and there is no separate Petition for Extension of Time filed herewith, this paper is to be construed as also constituting a Petition for Extension of Time for a period of time sufficient to enable this document to be timely filed.

No fee is believed due for filing this Reply Brief. However, should any fee under 37 C.F.R. §§ 1.16 to 1.21 be deemed necessary for any reason relating to this document, **the Director is authorized to deduct said fees from Advanced Micro Devices, Inc. Deposit Account No. 01-0365/TT3258.** In the event the monies in that account are insufficient, the Commissioner is authorized to withdraw funds from Williams, Morgan & Amerson, P.C., Deposit Account No. 50-0786/2000.045300/TT3258.

I. REAL PARTY IN INTEREST

The present application is owned by Advanced Micro Devices, Inc.

II. RELATED APPEALS AND INTERFERENCES

Appellants are not aware of any related appeals and/or interferences that might affect the outcome of this proceeding.

III. STATUS OF THE CLAIMS

Claims 2-6, 13-21 and 23-31 were withdrawn from consideration in the response to the Office Action mailed October 25, 2004. Claims 1, 7-12 and 22 are pending in the application. Claims 1, 7-12 and 22 stand rejected under 35 U.S.C. § 103(a), as being made unpatentable by U.S. Patent No. 6,428,673 B1 (***Ritzdorf***) in view of U.S. Patent 6,221,765 B1 (***Ueno***) and U.S. 6,298,470 B1 (***Breiner***). Claims 1, 7, 8, 10, 11, and 22 stand rejected under 35 U.S.C. § 103(a) as being made unpatentable by U.S. Patent No. 6,428,673 B1 (***Ritzdorf***) in view of U.S. Patent No. 6,221,765 B1 (***Ueno***) and U.S. Patent No. 6,211,094 B1 (***Jun***). The claims on appeal (claims 1, 7-12 and 22), as well as the previously withdrawn claims, are set forth in the Claims Appendix.

IV. STATUS OF AMENDMENTS

There were no amendments after the final rejections provided in the Final Office Action Dated October 25, 2004.

V. SUMMARY OF THE INVENTION

In general, the present invention is directed towards the manufacture of a semiconductor device. Appellants' inventive methodologies are generally directed to forming a copper layer on a semiconductor device, such as a semiconductor wafer. The inventive methodologies include averaging a plurality of thicknesses from a plurality of locations and comparing the measured thickness to desired thickness. The present patent application also discloses measuring a mechanical stress and varying the thickness based upon the actual thickness differing from the desired thickness and the mechanical stress.

In one aspect of the present invention, a method is provided. The method comprises forming a first dielectric layer above a first structure layer. A first opening is formed in the first dielectric layer, and a first copper layer is formed above the first dielectric layer and in the first opening. Thereafter, an actual thickness of the copper layer is measured and compared to a desired thickness. At least one parameter used to form the first copper layer is varied in response to the actual thickness differing from the desired thickness.

In another aspect of the present invention, a system is provided. The system is comprised of an electroplate tool, a metrology tool, and a controller. The electroplate tool is capable of depositing a layer of copper on a surface of a semiconductor device. The electroplate tool has at least one parameter that may be varied to control a thickness of the layer of copper. The metrology tool is capable of measuring the thickness of the copper layer and delivering a signal indicative thereof. The controller is adapted for receiving the signal, comparing the measured thickness to a desired thickness, and varying the at least one parameter in response to the measured thickness differing from the desired thickness.

In general, the present invention is directed towards the manufacture of a semiconductor device. As will be readily apparent to those skilled in the art upon a complete reading of the present application, the present method is applicable to a variety of technologies, for example, NMOS, PMOS, CMOS, and the like, and is readily applicable to a variety of devices, including, but not limited to, logic devices, memory devices, and the like. (*See*, Specification, page 7, lines 20 to 24).

As shown in Figure 1, a first dielectric layer 120 and a first conductive structure 140 (such as a copper intermetal via connection) may be formed above a structure layer 100 such as a

semiconducting substrate. However, the present invention is not limited to the formation of a copper (Cu)-based interconnect above the surface of a semiconducting substrate such as a silicon wafer, for example. Rather, as will be apparent to one skilled in the art upon a complete reading of the present disclosure, a copper (Cu)-based interconnect formed in accordance with the present invention may be formed above previously formed semiconductor devices and/or process layer, *e.g.*, transistors, or other similar structure. In effect, the present invention may be used to form process layers on top of previously formed process layers. The structure layer 100 may be an underlayer of semiconducting material, such as a silicon substrate or wafer, or, alternatively, may be an underlayer of semiconductor devices, such as a layer of metal oxide semiconductor field effect transistors (MOSFETs), and the like, and/or a metal interconnection layer or layers (see Figure 9, for example) and/or an interlevel (or interlayer) dielectric (ILD) layer or layers, and the like. (*See*, Specification, page 8, lines 1 to 15).

In a single-damascene copper process flow, according to various embodiments of the present invention, as shown in Figures 1-8, the first dielectric layer 120 is formed above the structure layer 100, adjacent the first conductive structure 140. As shown in Figure 1, the first dielectric layer 120 has an etch stop layer (ESL) 110 (typically silicon nitride, Si_3N_4, or SiN, for short) formed and patterned thereon, between the first dielectric layer 120 and a second dielectric layer 130 and adjacent the first conductive structure 140. The second dielectric layer 130 is formed above the etch stop layer (ESL) 110 and above the first conductive structure 140. The first dielectric layer 120 has the first conductive structure 140 disposed therein. If necessary, the second dielectric layer 130 may have been planarized using a chemical-mechanical polishing (CMP) process. The second dielectric layer 130 has an etch stop layer 160 (typically also SiN) formed and patterned thereon, between the second dielectric layer 130 and a patterned

photomask 150. The patterned photomask 150 is formed and patterned above the etch stop layer 160. (*See*, Specification, page 8, lines 17 to 25 and page 9, lines 1 to 4).

The first and second dielectric layers 120 and 130 may be formed from a variety of dielectric materials, including, but not limited to, materials having a relatively low dielectric constant (low K materials, where K is less than or equal to about 4), although the dielectric materials need not have low dielectric constants. The first and second dielectric layers 120 and 130 may be formed by a variety of known techniques for forming such layers, *e.g.*, a chemical vapor deposition (CVD) process, a low-pressure CVD (LPCVD) process, a plasma-enhanced CVD (PECVD) process, a sputtering process, a physical vapor deposition (PVD) process, a spin-on coating process (such as a spin-on glass process), and the like, and each may have a thickness ranging from approximately 3000 Å-8000 Å, for example. (*See*, Specification, page 7, lines 20 to 24). (*See*, Specification, page 9, lines 6 to 14).

The first and second dielectric layers 120 and 130 may be formed from a variety of low K dielectric materials, where K is less than or equal to about 4. Examples include Applied Material's Black Diamond®, Novellus' Coral®, Allied Signal's Nanoglass®, JSR's LKD5104, and the like. In one illustrative embodiment, the first and second dielectric layers 120 and 130 are each comprised of Applied Material's Black Diamond®, each having a thickness of approximately 5000 Å, each being formed by being blanket-deposited by an LPCVD process for higher throughput. (*See*, Specification, page 9, lines 16 to 22).

As shown in Figure 2, a metallization pattern is then formed by using a patterned photomask 150, the etch stop layers 160 and 110 (Figures 1-2), and photolithography. For example, openings (such as an opening or trench 220 formed above at least a portion of the first

conductive structure 140) for conductive metal lines, contact holes, via holes, and the like, are etched into the second dielectric layer 130 (Figure 2). The opening 220 has sidewalls 230. The opening 220 may be formed by using a variety of known anisotropic etching techniques, such as a reactive ion etching (RIE) process using hydrogen bromide (HBr) and argon (Ar) as the etchant gases, for example. Alternatively, an RIE process with CHF_3 and Ar as the etchant gases may be used, for example. Plasma etching may also be used in various illustrative embodiments. The etching may stop at the etch stop layer 110 and at the first conductive structure 140. (*See*, Specification, page 9, lines 24 to 25 and page 10, lines 1 to 9).

As shown in Figure 3, the patterned photomask 150 (Figures 1-2) is stripped off, by ashing, for example. Alternatively, the patterned photomask 150 may be stripped using a 1:1 solution of sulfuric acid (H_2SO_4) to hydrogen peroxide (H_2O_2), for example. (*See*, Specification, page 10, lines 11 to 13).

As shown in Figure 4, the etch stop layer 160 is then stripped off, by selective etching, for example. In various illustrative embodiments, for example, in which the etch stop layer 160 comprises silicon nitride (Si_3N_4), hot aqueous phosphoric acid (H_3PO_4) may be used to selectively etch the silicon nitride (Si_3N_4) etch stop layer 160. (*See*, Specification, page 10, lines 15 to 18).

As shown in Figure 5, a thin barrier metal layer 525A and a copper seed layer 525B (or a seed layer of another conductive material) are applied to the entire surface using vapor-phase deposition. The barrier metal layer 525A and the copper (Cu) seed layer 525B blanket-deposit an entire upper surface 530 of the second dielectric layer 130 as well as the side surfaces 230 and a

bottom surface 550 of the opening 220, forming a conductive surface 535, as shown in Figure 5. (*See*, Specification, page 10, lines 20 to 25).

The barrier metal layer 525A may be formed of at least one layer of a barrier metal material, such as tantalum (Ta) or tantalum nitride (TaN), and the like, or, alternatively, the barrier metal layer 525A may be formed of multiple layers of such barrier metal materials. For example, the barrier metal layer 525A may also be formed of titanium nitride (TiN), titanium-tungsten, nitrided titanium-tungsten, magnesium, a sandwich barrier metal Ta/TaN/Ta material, or another suitable barrier material. Tantalum nitride (TaN) is believed to be a good diffusion barrier to copper (Cu). Tantalum (Ta) is believed to be easier to deposit than tantalum nitride (TaN), while tantalum nitride (TaN) is easier to subject to a chemical mechanical polishing (CMP) process than tantalum (Ta). The copper seed layer 525B may be formed on top of the one or more barrier metal layers 525A by physical vapor deposition (PVD) or chemical vapor deposition (CVD), for example. (*See*, Specification, page 11, lines 1 to 12).

The bulk of the copper trench-fill is frequently done using an electroplating technique, where the conductive surface 535 is mechanically clamped to an electrode (not shown) to establish an electrical contact, and the structure layer 100 and overlying layers are then immersed in an electrolyte solution containing copper (Cu) ions. An electrical current is then passed through the workpiece-electrolyte system to cause reduction and deposition of copper (Cu) on the conductive surface 535. In addition, an alternating-current bias of the workpiece-electrolyte system has been considered as a method of self-planarizing the deposited copper (Cu) film, similar to the deposit-etch cycling used in high-density plasma (HDP) tetraethyl orthosilicate (TEOS) dielectric depositions. (*See*, Specification, page 11, lines 14 to 22).

As shown in Figure 6, this process typically produces a conformal coating of a copper (Cu) layer 640 of substantially constant thickness across the entire conductive surface 535. The copper (Cu) layer 640 may then be annealed using a rapid thermal anneal (RTA) process performed at a temperature ranging from approximately 100-400°C for a time ranging from approximately 10-180 seconds. Alternatively, the copper (Cu) layer 640 may be annealed using a furnace anneal process at a temperature ranging from approximately 100-400°C for a time ranging from approximately 10-90 minutes. In various alternative embodiments, the copper (Cu) layer 640 may be annealed using a rapid thermal anneal (RTA) process performed at a temperature ranging from approximately 250-350°C for a time ranging from approximately 10-180 seconds. In still other various illustrative embodiments, the copper (Cu) layer 640 may be annealed using a furnace anneal process at a temperature ranging from approximately 250-350°C for a time ranging from approximately 10-90 minutes. (*See*, Specification, page 11, lines 24 to 25 and page 12, lines 1 to 10).

A post-formation anneal may be used to accelerate room-temperature grain growth in the copper (Cu) layer 640, and, consequently, may affect the mechanical stress state of the copper (Cu) layer 640. In particular, the post-formation anneal of over-filled damascene openings, such as opening 220 shown in Figure 6, affects the mechanical stress state of the copper (Cu) layer 640. For anneals performed at temperatures ranging from about 150-400°C, the copper (Cu) layer 640 is in a relatively low mechanical stress state that is effectively mechanical stress-free, or slightly compressive, since the copper (Cu) has no native oxide strengthening mechanism and since the copper (Cu) grain size is small. The copper (Cu) grain growth in the small-grained copper (Cu) layer 640 under compression will act to relax the mechanical stress. In the copper (Cu) in the opening 220 covered by the sufficiently thick layer of the copper (Cu)

layer 640, it is likely that the mechanical stress in the copper (Cu) would be about zero or at least very small at the anneal temperatures ranging from about 150-400°C. The microstructure of the copper (Cu) in the opening 220 is influenced by the sufficiently thick layer of the copper (Cu) layer 640, and it is believed that the mechanical stress in the copper (Cu) in the opening 220 is also influenced by the sufficiently thick layer of the copper (Cu) layer 640. (*See*, Specification, page 12, lines 12 to 25 and page 13, lines 1 to 2).

Upon cooling from the anneal, the mechanical stress in the copper (Cu) in the opening 220 is tensile. Since the copper (Cu) of the copper (Cu) layer 640 has a thickness, measured from the bottom of the opening 220, in a range of approximately 3000 Å-8000 Å, for example, the mechanical stress in the copper (Cu) in the opening 220 is relatively small, with hydrostatic stresses in a range of from about 50 MPa to about 200 MPa. (*See*, Specification, page 13, lines 4 to 8).

The mechanical stress in the copper (Cu) in the opening 220 is tensile, after cooling down from the anneal, due in part to the difference in the coefficient of thermal expansion (ΔCTE) between the copper (Cu) in the copper (Cu) layer 640 and the semiconducting material of the structure layer 100. For example, the coefficient of thermal expansion (CTE) for silicon (Si) is about 2.6×10^{-6}/°C, the coefficient of thermal expansion (CTE) for copper (Cu) is about 16.6×10^{-6}/°C, and the coefficient of thermal expansion (CTE) for aluminum (Al) is about 23.1×10^{-6}/°C. Therefore, the difference in the coefficient of thermal expansion (ΔCTE) between copper (Cu) and silicon (Si) is about 14.0×10^{-6}/°C. For the sake of comparison, the difference in the coefficient of thermal expansion (ΔCTE) between aluminum (Al) and silicon (Si) is about 20.5×10^{-6}/°C, or about 1.46 times larger than the difference in the coefficient of thermal

expansion (ΔCTE) between copper (Cu) and silicon (Si). The difference in the coefficient of thermal expansion (ΔCTE) is the dominant source of mechanical strain in a metallic interconnect. (*See*, Specification, page 13, lines 10 to 22).

The mechanical stress may be calculated from the mechanical strain using mechanical stiffness coefficients. An order of magnitude estimate of the mechanical stress may be calculated using the biaxial modulus. The biaxial modulus of silicon (Si) is about 1.805×10^{5} MPa (MegaPascals), the biaxial modulus of copper (Cu) is about 2.262×10^{5} MPa, and the biaxial modulus of aluminum (Al) is about 1.143×10^{5} MPa, or about half the biaxial modulus of copper (Cu). (*See*, Specification, page 13, lines 24 to 25 and page 14, lines 1 to 4).

In one illustrative embodiment, copper (Cu) lines having critical dimensions of about 0.25 μm, and a thickness of approximately 4500 Å, similar to the copper (Cu) layer 640, are subjected to a post-plating anneal using a furnace anneal process performed at a temperature of approximately 250°C for a time of approximately 30 minutes. The mechanical stresses measured along the lengths (X direction, into the page of Figure 6) of these copper (Cu) lines are about 300 MPa, the mechanical stresses measured along the widths (Y direction, horizontal arrows in Figure 6) of these copper (Cu) lines are about 160 MPa, and the mechanical stresses measured along the heights (Z direction, horizontal arrows in Figure 6) of these copper (Cu) lines are about 55 MPa. The hydrostatic mechanical stress measured with these copper (Cu) lines is about 175 MPa. (*See*, Specification, page 14, lines 6 to 15).

These mechanical stress levels appear to be a function of the post-plating anneal temperature. By way of comparison, copper (Cu) lines having critical dimensions of about 0.25 μm, and a thickness of approximately 4500 Å, similar to the copper (Cu) layer 640,

subjected to a post-plating anneal using a furnace anneal process performed at a higher temperature of approximately 500°C for the same time of approximately 30 minutes have been measured to have the following mechanical stresses. The mechanical stresses measured along the lengths (X direction) of these copper (Cu) lines are about 600 MPa, the mechanical stresses measured along the widths (Y direction) of these copper (Cu) lines are about 470 MPa, and the mechanical stresses measured along the heights (Z direction) of these copper (Cu) lines are about 230 MPa. The hydrostatic mechanical stress measured with these copper (Cu) lines is about 440 MPa. Since hydrostatic mechanical stress is the driving force for void formation in metallic interconnects, efforts should be made to reduce this hydrostatic mechanical stress. Thus, the post-plating anneal temperature should be lowered to reduce this hydrostatic mechanical stress. For example, a post-plating furnace anneal process performed at approximately 250°C for approximately 30 minutes, which produces a hydrostatic mechanical stress of about 175 MPa, is preferable to a post-plating furnace anneal process performed at approximately 500°C for approximately 30 minutes, which produces a hydrostatic mechanical stress of about 440 MPa. (*See*, Specification, page 14, lines 17 to 25 and page 15, lines 1 to 9).

As shown in Figure 7, following the post-deposition anneal described above, the layer of the copper (Cu) layer 640 is planarized using chemical mechanical polishing (CMP) techniques. The planarization using CMP clears all copper (Cu) and barrier metal from the entire upper surface 530 of the second dielectric layer 130, leaving a copper (Cu) portion 740 of the copper (Cu) layer 640 remaining in a metal structure such as a copper (Cu)-filled trench, forming a copper (Cu)-interconnect 745, adjacent remaining portions 725A and 725B of the one or more barrier metal layers 525A and copper seed layer 525B (Figures 5 and 6), respectively, as shown in Figure 7. (*See*, Specification, page 15, lines 11 to 18).

As shown in Figure 7, the copper (Cu)-interconnect 745 may be formed by annealing the copper (Cu) portion 740, adjacent the remaining portions 725A and 725B of the one or more barrier metal layers 525A and copper seed layer 525B (Figures 5 and 6), to the first conductive structure 140. The anneal process may be performed in a traditional tube furnace, at a temperature ranging from approximately 100-500°C, for a time period ranging from approximately 10-90 minutes, in a nitrogen-containing ambient that may include at least one of ammonia (NH_3), molecular nitrogen (N_2), molecular hydrogen (H_2), argon (Ar), and the like. Alternatively, the anneal process may be a rapid thermal anneal (RTA) process performed at a temperature ranging from approximately 100-500°C for a time ranging from approximately 10-180 seconds in a nitrogen-containing ambient that may include at least one of molecular nitrogen (N_2), molecular hydrogen (H_2), argon (Ar), and the like. (*See*, Specification, page 15, lines 20 to 25 and page 16, lines 1 to 5).

As shown in Figure 8, the second dielectric layer 130 may be planarized, as needed, using chemical mechanical polishing (CMP) techniques. Planarization would leave the planarized second dielectric layer 130 adjacent the copper (Cu)-interconnect 745 and above the etch stop layer 110, forming a copper (Cu)-interconnect layer 800. The copper (Cu)-interconnect layer 800 may include the copper (Cu)-interconnect 745 adjacent the second dielectric layer 130. The copper (Cu)-interconnect layer 800 may also include the etch stop layer 110. As shown in Figure 8, the copper (Cu)-interconnect layer 800 may also include an etch stop layer 820 (also known as a "hard mask" and typically formed of silicon nitride, Si_3N_4, or SiN, for short) formed and patterned above the second dielectric layer 130 and above at least a portion of the copper (Cu)-interconnect 745. (*See*, Specification, page 16, lines 7 to 16).

As shown in Figure 9, the copper (Cu)-interconnect layer 800 may be an underlying structure layer (similar to the structure layer 100) to a copper (Cu)-interconnect layer 900. The copper (Cu)-interconnect layer 900 may include a copper (Cu)-filled trench 940 and an intermetal via connection 910 adjacent a planarized dielectric layer 935. The intermetal via connection 910 may be a copper (Cu) structure similar to the first copper (Cu) structure 140, and the intermetal via connection 910 may be annealed to the copper (Cu)-filled trench 940 in a similar fashion to the anneal described above in relation to the formation of the copper (Cu)-interconnect 745 (Figure 7). The copper (Cu)-interconnect layer 900 may also include the etch stop layer 820 and/or etch stop layer 915 and/or etch stop layer 920 (also known as "hard masks" and typically formed of silicon nitride, Si_3N_4, or SiN, for short) formed and patterned above the planarized dielectric layers 925 and/or 935, respectively. The etch stop layer 920 may also be formed above at least a portion of the copper (Cu)-filled trench 940. (*See*, Specification, page 16, lines 18 to 25 and page 17, lines 1 to 4).

Turning now to Figure 10, one illustrative embodiment of a system 1000 that may be used to produce the features of the semiconductor device depicted in Figures 1-9 is shown. The system 1000 processes wafers 1002 and is generally comprised of a photolithography tool 1004, a stepper 1006, an etcher 1007, a barrier deposition tool 1008, an electroplate tool 1009, a metrology tool 110, and a controller 1012. The wafer 1002 is generally serially processed within each of the tools 1004-1009, and then analyzed in the metrology tool 1010. Those skilled in the art will appreciate that more or fewer tools may be included in the system 1000 as is warranted to produce the desired features on the wafer 1002. (*See*, Specification, page 17, lines 6 to 13).

Generally, the photolithography tool 1004 forms a layer of photoresist on the wafer 1002. The stepper 1006 controllably exposes the layer of photoresist to a light source through a mask

or reticle to produce a desired pattern in the layer of photoresist. The etcher 1007 removes those portions of layers underlying the layer of photoresist that are exposed by the patterning produced by the mask to produce openings and/or holes in a desired pattern. The thin barrier metal layer is deposited by a barrier deposition tool 1008. The electroplate tool 1009 forms a layer or film of copper on the surface of the wafer 1002, filling the openings and/or holes. The metrology tool 1010 measures select parameters of the wafer 102, such as physical characteristics and/or electrical properties. The measured physical characteristics may include thickness of the copper layer, feature sizes, depth of an etching process, etc. The measured electrical properties may include resistance, conductivity, voltage levels, etc. In some embodiments, the metrology tool 1010 may not be needed, as sufficient feedback information for controlling parameters of the tools 1004-1009 may be obtained from sensors within the tools 1004-1009. (*See*, Specification, page 17, lines 15 to 25 and page 18, lines 1 to 3).

The metrology tool 1010 may be any of a variety of devices used to measure electrical and/or structural features on the wafer 1002 after being processed by the tools 1004-1009. For example, the metrology tool 1010 may be configured to measure feature sizes on the wafer 1002, such as the thickness of the copper layer, and provide the measurement data to the controller 1012. Measurements of this type may be useful in determining whether the electroplating process has produced a layer of copper having a desired thickness, and then modifying the operation of the electroplate tool 1009, if necessary, so that subsequently processed wafers 1002 have the desired thickness. Such a metrology tool is available from Rudolph Technologies as model number 200, Tencor as Model NC110, or the like. It is contemplated that in some embodiments of the instant invention additional tools (not shown) may be deployed in the manufacturing line, such as additional metrology tools 1010 positioned to measure certain

mechanical or electrical parameters of the wafer 1002 at various steps in the manufacturing process. Alternatively, additional tools may be deployed intermediate the etcher 1007 and the electroplate tool 1009. These intermediate devices may perform additional processes, such as cleaning, rinsing, forming additional layers, etc. Moreover, it is anticipated that the formation of some of the features on the wafer 1002 will be produced by operations performed by the tools 1004-1009 other than in the order illustrated. For example, it may be useful to route the wafer 1002 through the photolithography tool 1004, stepper 1006 and etcher 1007 a plurality of times before delivering the wafer 1002 to the electroplate tool 1009. (*See*, Specification, page 18, lines 5 to 24).

The etcher 1007 may be any of a variety of devices capable of removing underlying process layers not protected by the layer of photoresist. For example, an etcher commercially available from Applied Materials as model 5000-DPS may be used. Any of a variety of etchants may be employed without departing from the spirit and scope of the instant invention. In one exemplary embodiment, the etcher 1007 employs plasma etching. (*See*, Specification, page 19, lines 1 to 5).

The controller 1012 of Figure 10 may take a variety of forms. For example, the controller 1012 may be included within the tools 1004-1010, or it may be a separate device electrically coupled to the tools 1004-1010 via lines 1014-1020, respectively. In the embodiment illustrated herein, the controller 1012 takes the form of a computer that is controlled by a variety of software programs. The software programs that directly relate to controlling and or monitoring the electroplate tool 1009 are discussed in greater detail below in conjunction with Figures 12-13. Those of ordinary skill in the art having the benefit of this disclosure will appreciate that the controller 1012 need not rely on software for its functionality, but rather, a

hardware controller may be used to provide the functionality described herein and attributed to the controller 1012. Further, the controller 1012 need not be coupled only to the tools 1004-1010, but rather, could be coupled to and involved in controlling or collecting data from other devices involved in the manufacture of semiconductor devices. (*See*, Specification, page 19, lines 7 to 19).

In the illustrated embodiment, the automatic process controller 1012 is a computer programmed with software to implement the functions described. However, as will be appreciated by those of ordinary skill in the art, a hardware controller (not shown) designed to implement the particular functions may also be used. Moreover, the functions of the controller described herein may be performed by one or more processing units that may or may not be geographically dispersed. Portions of the invention and corresponding detailed description are presented in terms of software, or algorithms and symbolic representations of operations on data bits within a computer memory. These descriptions and representations are the ones by which those of ordinary skill in the art effectively convey the substance of their work to others of ordinary skill in the art. An algorithm, as the term is used here, and as it is used generally, is conceived to be a self-consistent sequence of steps leading to a desired result. The steps are those requiring physical manipulations of physical quantities. Usually, though not necessarily, these quantities take the form of optical, electrical, or magnetic signals capable of being stored, transferred, combined, compared, and otherwise manipulated. It has proven convenient at times, principally for reasons of common usage, to refer to these signals as bits, values, elements, symbols, characters, terms, numbers, or the like. (*See*, Specification, page 19, lines 21 to 25 and page 20, lines 1 to 11).

It should be borne in mind, however, that all of these and similar terms are to be associated with the appropriate physical quantities and are merely convenient labels applied to these quantities. Unless specifically stated otherwise, or as is apparent from the discussion, terms such as "processing" or "computing" or "calculating" or "determining" or "displaying" or the like, refer to the actions and processes of a computer system, or similar electronic computing device, that manipulates and transforms data represented as physical, electronic quantities within the computer system's registers and memories into other data similarly represented as physical quantities within the computer system memories or registers or other such information storage, transmission or display devices. (*See*, Specification, page 20, lines 13 to 21).

An exemplary software system capable of being adapted to perform the functions of the automatic process controller 1012, as described, is the KLA Tencor Catalyst system offered by KLA Tencor, Inc. The KLA Tencor Catalyst system uses Semiconductor Equipment and Materials International (SEMI) Computer Integrated Manufacturing (CIM) Framework compliant system technologies, and is based on the Advanced Process Control (APC) Framework. CIM (SEMI E81-0699 - Provisional Specification for CIM Framework Domain Architecture) and APC (SEMI E93-0999 - Provisional Specification for CIM Framework Advanced Process Control Component) specifications are publicly available from SEMI. (*See*, Specification, page 20, lines 23 to 25 and page 21, lines 1 to 6).

Turning now to Figure 11, a stylized representation of the electroplater tool 1009 is shown. Generally, a tank 1100 contains a bath 1102. The wafer 1002 is immersed in the bath 1102 and coupled to electrical ground. Typically, the bath is composed of a salt of the metal to be plated. Thus, in the illustrated embodiment, the bath 1102 is a solution containing a copper salt, such as copper chloride, copper sulfate, or the like. A copper anode 1104 is also immersed

in the bath 1102, and is coupled to receive an electrical signal from a controller 1106 over a line 1108. Thus, electricity flows from the copper anode to the grounded wafer 1002, transporting copper atoms from the anode 1104 to the bath 1102, and from the bath 1102 to the surface of the wafer 1002. The process continues for a preselected period of time to produce a conformal layer or film of copper similar to the layer 640 illustrated in Figure 6. The electroplate tool 1009 may be any of a variety of devices capable of depositing a layer of copper on a semiconductor wafer. For example, an electroplate tool commercially available from Semitool as model LT-210t, Novellus as the Sabre model, or the like may be used. (*See*, Specification, page 21, lines 8 to 21).

The thickness of the copper layer 640 may be controlled by altering a variety of parameters. First, the duration that the wafer 1002 remains in the electrolytic solution 1102 with current passing from the anode 1104 to the wafer 1002 will directly impact the thickness of the copper layer 140. That is, reducing the period of time will reduce the thickness of the copper layer 640, and increasing the period of time will increase the thickness of the copper layer. The rate at which the thickness of the copper layer increases may not be constant, but rather, may vary over time, depending upon the condition of the anode 1104 and the bath 1102. Moreover, the type of features present on the wafer 1002 may also impact the rate. For example, increasing the number of features may produce a greater surface area, which may impact the rate at which the thickness of the copper layer 640 increases. (*See*, Specification, page 21, lines 23 to 25 and page 22, lines 1 to 7).

Varying the voltage and/or current applied to the anode 1104 may also impact the rate at which the thickness of the copper layer 640 increases. For example, increasing the voltage/current may raise the rate at which copper is deposited on the wafer 1002. Conversely,

lowering the voltage/current may reduce the rate at which copper is deposited on the wafer 1002. Generally, maintaining the voltage applied to the copper anode 1104 in the range of about 2 to 4 volts produces acceptable electroplating characteristics. (*See*, Specification, page 22, lines 9 to 14).

Additionally, the controller 1106 may be configured to provide an AC signal. Varying the frequency, magnitude, and/or shape of the AC signal may also also impact the rate at which the thickness of the copper layer 640 increases. For example, increasing the current may raise the rate at which copper is deposited on the wafer 1002. Conversely, lowering the current may reduce the rate at which copper is deposited on the wafer 1002. Generally, maintaining the current applied to the copper anode 1104 in the range of about 1 to 10 milliamps produces acceptable electroplating characteristics. (*See*, Specification, page 22, lines 16 to 22).

The controller 1106 of the electroplate tool 1019 is coupled to the controller 1012 over the line 1019. This connection allows the controller 1012 to deliver signals that instruct the controller 1106 to vary some or all of the parameters discussed above to alter the thickness of the copper layer 640 based on data received from the metrology tool 1010. For example, if the metrology tool 1010 detects that the copper layer 640 is too thin, then the controller 1012 delivers a control signal to the controller 1106, instructing the controller 1106 to alter one or more of its parameters to increase the thickness of the copper layer 640. (*See*, Specification, page 22, lines 24 to 25 and page 23, lines 1 to 5).

Referring to Figure 12, one illustrative embodiment of a process 1200 used to produce features of the type depicted in Figures 1-9 is generally shown in flowchart form. As shown therein, the present invention comprises the process 1200 beginning at block 1202 where a

process layer is formed on the wafer 1200. Thereafter, a layer of photoresist is formed above the process layer, as indicated at block 1204. The method further comprises patterning the layer of photoresist, as indicated at block 1206, and etching away select portions of the underlying process layer, as indicated at block 1208. In block 1210, a layer of copper is formed on the surface of the process layer and in the openings created by the etching process. Thereafter, in block 1212, the wafer 1002 is analyzed to determine the thickness of the copper layer. The controller 1012 uses the thickness measurement to vary the parameters of the copper forming process so as to increase/decrease the thickness of subsequently formed copper layers, as needed. (*See*, Specification, page 23, lines 7 to 18).

Turning now to Figure 13, a flowchart depiction of a process 1300 used to vary the parameters of the electroplate tool 1009, as identified in the block 1212, is shown. The process 1300 begins at block 1302 with the metrology tool 1010 measuring the thickness of the copper layer 640. The thickness of the copper layer 640 may be determined using a variety of processes. For example, a single measurement may be taken. Alternatively, a plurality of measurements may be made at preselected spaced apart locations on the surface of the wafer 1002. Where a plurality of measurements are made, a criteria may be established for determining the thickness of the layer 640. The criteria may involve averaging the measurements, determining the median value, using the worst case measurement, using the best case measurement, using a ruling majority of measurements, etc. In block 1302, the selected criteria is applied to the measurements to determine the actual thickness of the copper layer 640. (*See*, Specification, page 23, lines 20 to 25 and page 24, lines 1 to 6).

In block 1304, the actual thickness of the copper layer 640 is compared to a desired thickness. As long as the two measurements are within acceptable limits of one another, no

action is taken to vary the parameters of the electroplate tool 1009. Where the comparison of the measurements is outside a desired range, the magnitude of the difference is recorded along with an indication of whether the actual thickness is greater or less than the desired thickness. (*See*, Specification, page 24, lines 8 to 13).

In an alternative embodiment, where a plurality of spatially separated measurements of the thickness of the copper layer 640 are made, it may be useful to compare each of these measurements to a desired thickness. In this embodiment, the desired thickness may be the same for each measurement, or it may vary. That is, a desired thickness at position A on the wafer 1002 may be greater or less than a desired thickness at position B. (*See*, Specification, page 24, lines 15 to 19).

In block 1306, the process 1300 determines a desired parameter for the electroplate tool 1009 so as to produce the desired thickness of the copper layer 640. Determining the desired parameter may be accomplished by a formula and/or a lookup table. The values stored in the lookup table and/or the formula may be derived theoretically, or may be determined empirically. That is, a formula that correlates the thickness of the copper layer with parameters, such as time, voltage, current, waveshape, frequency, etc. may be used to calculate the desired setting for the electroplate tool 1009. Alternatively, a series of test runs at a variety of times, voltages, currents, waveshapes, frequencies, etc. may be performed to determine an actual thickness of the copper layer 640 at a variety of these parameters. These empirically determined parameters may then be stored in a lookup table and accessed by the process 1300. Alternatively, the desired parameter of the electroplate tool 1009 may be iteratively adjusted until a desired thickness for the copper layer 640 is observed by the metrology tool 1010. That is, each time a wafer 102 is processed by the electroplate tool 1009 and measured by the metrology tool 1010, the desired parameter may

be iteratively adjusted by an amount proportional to the difference between the desired and actual thickness. That is, the greater the difference in thickness, the greater the correction to the desired parameter. (*See*, Specification, page 24, lines 21 to 25 and page 25, lines 1 to 12).

Finally, in block 1308, the desired parameter is communicated to the electroplate tool 1009. The controller 1106 in the electroplate tool 1009 responds by varying the parameter to its new, desired setting for subsequently processed wafers 1002. (*See*, Specification, page 25, lines 14 to 16).

Of course, the present invention should not be considered as limited to the specifically disclosed embodiments discussed immediately above.

VI. ISSUES ON APPEAL

1. Whether or not claims 1, 7-12 and 22 are made unpatentable by U.S. Patent No. 6,428,673 (***Ritzdorf***) in view of U.S. Patent 6,221,765 (***Ueno***) and U.S. 6,298,470 (***Breiner***), pursuant to 35 U.S.C. § 103(a).

2. Whether or not claims 1, 7, 8, 10, 11, and 22 are made unpatentable by U.S. Patent No. 6,428,673 (***Ritzdorf***) in view of U.S. Patent 6,221,765 (***Ueno***) and U6,211,094 (***Jun***), pursuant to 35 U.S.C. § 103(a).

VII. ARGUMENT

In a Final Office Action dated June 8, 2005 (mailed subsequent to the Appeal Brief filed by the Appellants), the Examiner provided a request for information under 37 C.R.F. 1.105. The Examiner requested all information available for the devices relating to Rudolph and Tencor

originally cited as examples of metrology instruments. Although Appellants maintain that such information is moot in light of the amendments to the Specification that deleted any reference to these examples, Appellants responded to the Examiner's request. Pursuant to 37 C.F.R. 1.105(4)(b), Appellants provided all available information relating to the Rudolph metrology instrument. Further, information relating to the Tencor example is not known and/or is not readily available to Appellants. Therefore, pursuant to 37 C.F.R. 1.105(4), all requirements made by the Examiner under 37 C.F.R. 1.105 have been satisfied. Appellants respectfully assert that the information relating the Rudolph attached herewith does not affect Examination of the present application. This is particularly true since the Rudolph metrology instrument was merely listed as an example of a metrology tool that may be used by embodiments of the present invention. Since references to Rudolph and Tencor were deleted from the Specification, Examiner's request under 37 C.F.R. 1.105 relating to the deleted matter are moot and should be dismissed.

Further, Appellants respectfully assert that removals of the examples of metrology tools (Rudolph and Tencor) do not constitute new matter. The Examiner erred in asserting that removal of mere examples of metrology tools that could be used with embodiments of the present invention constitutes new art. Appellants respectfully assert that the removal of the examples do not constitute removal of admitted prior art as asserted by the Examiner. Rudolph and Tencor were cited at examples of metrology tools that may be implemented with embodiments of the present invention. Appellants did not provide any assertions that would indicate an admission of prior art relating to the examples of the metrology tools (Rudolph and Tencor). Appellants respectfully assert that removal of the references to Rudolph and Tencor does not constitute new matter.

Appellants assert that the issue relating to Examiner's request under 37 C.F.R. 1.105 is moot as a result to the amendment to the Specification removing any references to Rudolph and Tencor. Deleting this section does not constitute adding new material to the specification. This requirement of information is now moot and Appellants respectfully request that the Examiner request be dismissed. Further for the convenience of the Office, Appellants have provided the Examiner with all available information relating to the request under 37 C.F.R. 1.105. However, Appellants maintain that such information is moot in light of the amendments to the specification that deleted any reference to these examples,. The attached documents relating to the Rudolph example are "Operating Your MetaPULSE System" and "MetaPULSE Administrator's Guide". For at least the reasons provided below, these documents do not constitute new evidence. Further, information relating to the Tencor example is not known and/or is not readily available to Appellants. Therefore, pursuant to 37 C.F.R. 1.105(4), all requirements made by the Examiner under 37 C.F.R. 1.105 are satisfied. Appellants respectfully assert that the information relating the Rudolph attached herewith does not affect Examination of the present application. This is particularly true since the Rudolph metrology instruments was merely listed as an example of a metrology tool that may be used by embodiments of the present invention. Appellants respectfully assert that information relating to the Rudolph example of a metrology tool does not affect the claims or Examiner's rejections. Hence Appellants respectfully ask that the Board dismiss Examiner's assertion that the removal of examples provided in the Specification constitutes new matter, and respectfully request that the Board move forward the Appeal process of the present application.

Additionally, Appellants respectfully assert that information relating to the Rudolph example is not new evidence since it was discussed and argued previously. Further, information

relating to the Rudolph is not relevant to the allowability of the claims since this information merely refers to examples of metrology tools that may be used with embodiments of the present invention. Therefore, this information is not required to assess the merits of the arguments provided in this Appeal. Previously, Appellants had deleted the references to the Rudolph and Tencor examples from the Specification. This matter has been discussed in previous office actions and responses. Therefore, information relating to Rudolph does not constitute new evidence. Appellants respectfully request that the Board dismiss Examiner's request under 37 C.F.R. 1.105 and decide the case on the merits of the arguments provided herein. Appellants respectfully assert that the information relating to the Rudolph example is provided in the Evidence Appendix and it does not constitute new evidence for the reasons cited herein.

As described above, the present invention provides for forming a copper layer on a semiconductor device, such as a semiconductor wafer. The present invention also provides for averaging a plurality of thicknesses from a plurality of locations and comparing the measured thickness to desired thickness. The present patent application also discloses measuring a mechanical stress and varying the thickness based upon the actual thickness differing from the desired thickness and the mechanical stress.

The Examiner relies heavily on U.S. Patent No. 6,428,673 (***Ritzdorf***), which discloses that a metrology system can feed forward or feed back uniformity and thickness data to drive a process recipe for electroplating reactors. However, Appellants respectfully assert that ***Ritzdorf*** does not disclose forming an opening upon a first dielectric layer that is formed above a structure upon which the copper layer is formed and controlling a parameter based upon a measured thickness, as called for by claims of the present invention. Also, ***Ritzdorf*** does not disclose

averaging the thickness from a plurality of sites on a copper layer as called for by claims of the present invention.

Additionally, the Examiner also relies on U.S. Patent No. 6,221,765 (***Ueno***), which provides the disclosure of residual tensile stress being present on a plating film. However, contrary to the Examiner's arguments, ***Ueno*** does not show why knowing the specific quantity of stress in a copper layer is important, ***Ueno*** merely points out that residual tensile stress may be present and makes a guess that the stress may be the result of shrinking of a plating film.

Furthermore, the Examiner also relies on U.S. Patent No. 6,298,470 (***Breiner***), which is directed to extrapolating known data to a new technology to determine and improve yields. ***Breiner*** discloses using data relating to previous generation IC manufacturing technology and applying them to new generation IC manufacturing technology (see for example, col. 2, lines 54-65, col. 13, lines 44-56). Although ***Breiner*** makes a passing reference to a "mean" value of data points, as described above, ***Breiner*** does not disclose or make obvious varying at least one parameter used to form the first copper layer in response to the actual thickness differing from the desired thickness and mechanical stress, as called for by claims of the present invention. Contrary to the Examiner's arguments, the disclosure of multiple measurements for each data point in ***Breiner*** does not refer to averaging a plurality of thicknesses from a plurality of locations on a copper layer, as called for by claims of the present invention.

Furthermore, the Examiner also relies on U.S. Patent Patent No. 6,211,094 (***Jun***), which merely discloses measurement of wafers that are analyzed for thickness at various zones. Appellants respectfully assert that ***Jun*** does not disclose averaging the plurality of thicknesses, and called for by claims of the present invention. Further, ***Jun*** does not disclose comparing the

actual thickness to a desired thickness, nor does it disclose measuring a mechanical thickness, as called for by claims of the present invention.

Therefore, the Examiner's erroneous combination of ***Ritzdorf***, ***Ueno***, ***Breiner*** and the erroneous combination of ***Ritzdorf***, ***Ueno***, ***Jun***, do not teach, suggest, or make obvious all of Group I, II and III claims of the present invention.

The specific claims of the present invention are discussed below.

A. **Claims 1 and 22 (Group I claims) , claims 7-9 (Group II claims), and claims 10-12 (Group III claims) are not anticipated or made obvious by U.S. Patent No. 6,428,673 (*Ritzdorf*) in view of U.S. Patent No. 6,221,765 (*Ueno*) and U.S. Patent No. 6,298,470 (*Breiner*) pursuant to 35 U.S.C. § 103(a).**

To establish a *prima facie* case of obviousness, three basic criteria must be met. First, the prior art reference (or references when combined) must teach or suggest all the claim limitations. Second, there must be some suggestion or motivation, either in the references themselves or in the knowledge generally available to one of ordinary skill in the art, to modify the reference or to combine reference teachings. Third, there must be a reasonable expectation of success. The teaching or suggestion to make the claimed combination and the reasonable expectation of success must both be found in the prior art, and not based on applicant's disclosure. *In re Vaeck*, 947 F.2d 488, 20 U.S.P.Q.2d 1438 (Fed. Cir. 1991); M.P.E.P. § 2142. Moreover, all the claim limitations must be taught or suggested by the prior art. *In re Royka*, 490 F.2d 981, 180 U.S.P.Q. 580 (CCPA 1974). If an independent claim is non-obvious under 35 U.S.C. § 103, then any claim depending therefrom is non-obvious. *In re Fine*, 837 F.2d 1071, 5 U.S.P.Q.2d 1596 (Fed. Cir. 1988); M.P.E.P. § 2143.03.

With respect to alleged obviousness, there must be something in the prior art as a whole to suggest the desirability, and thus the obviousness, of making the combination. *Panduit Corp. v. Dennison Mfg. Co.*, 810 F.2d 1561 (Fed. Cir. 1986). In fact, the absence of a suggestion to combine is dispositive in an obviousness determination. *Gambro Lundia AB v. Baxter Healthcare Corp.*, 110 F.3d 1573 (Fed. Cir. 1997). The mere fact that the prior art can be combined or modified does not make the resultant combination obvious unless the prior art also suggests the desirability of the combination. *In re Mills*, 916 F.2d 680, 16 U.S.P.Q.2d 1430 (Fed. Cir. 1990); M.P.E.P. § 2143.01. The consistent criterion for determining obviousness is whether the prior art would have suggested to one of ordinary skill in the art that the process should be carried out and would have a reasonable likelihood of success, viewed in the light of the prior art. Both the suggestion and the expectation of success must be founded in the prior art, not in the Applicant's disclosure. *In re Vaeck*, 947 F.2d 488, 20 U.S.P.Q.2d 1438 (Fed. Cir. 1991; *In re O'Farrell*, 853 F.2d 894 (Fed. Cir. 1988); M.P.E.P. § 2142. Appellants respectfully assert that the Examiner did not meet the legal standards to reject claims 8 and 33 under 35 U.S.C. § 103(a), including because of the fact that the prior art references (***Ritzdorf***, ***Ueno***, and ***Breiner***) does not teach or suggest all the claim limitations of claims 1, 7-12, and 22.

Groups I, II, and III (Claims [1 & 22], [7-9], and [10-12], respectively) Are Allowable

In the Final Office Action Dated October 25, 2004, the Examiner rejected claims 1, 7-12, and 22, under 35 U.S.C. § 103(a) as being unpatentable over U.S. Patent No. 6,428,673 (***Ritzdorf***) in view of U.S. Patent No. 6,221,765 (***Ueno***) and U.S. Patent No. 6,298,470

(***Breiner***). Appellants respectfully assert that the Examiner erred in rejecting claims 1, 7-12, and 22, and assert that these claims are allowable.

Ritzdorf discloses that a metrology system can feed forward or feed back uniformity and thickness data to drive a process recipe for electroplating reactors. However, ***Ritzdorf*** does not disclose averaging the thickness from a plurality of sites on a copper layer. Also, contrary to the Examiner's arguments, ***Ueno*** does not show why knowing the specific quantity of stress in a copper layer is important, ***Ueno*** merely points out that residual tensile stress may be present and makes a guess that the stress may be the result of shrinking of a plating film. Further, the disclosure of multiple measurements for each data point in ***Breiner*** does not refer to averaging a plurality of thicknesses from a plurality of locations on a copper layer, as called for by claims of the present invention. The combination of ***Ritzdorf***, ***Ueno***, ***Breiner*** do not disclose or make obvious all of the elements of claims 1, 7-12, and 22 of the present invention.

In the Final Office Action Dated October 25, 2004, the Examiner stated that Appellants ignored ***Ritzdorf's*** (U.S. Patent No. 6,428,673) use of metrology to control copper deposition. *See*, Final Office Action Dated October 25, 2004, page 9. Appellants respectfully assert that Appellants did not ignore any aspect of ***Ritzdorf***, instead Appellants merely pointed out that ***Ritzdorf*** does not disclose forming an opening upon a first dielectric layer that is formed above a structure upon which the copper layer is formed and controlling a parameter based upon a measured thickness, as called for by claims of the present invention. Also, Appellants have pointed out that ***Ritzdorf*** does not disclose averaging the thickness from a plurality of sites on a copper layer as called for by claims of the present invention. ***Ritzdorf*** discloses that a metrology system can feed forward or feed back uniformity and thickness data to drive a process recipe for

electroplating reactors. *See*, col. 4, lines 38-41. However, this neither reads upon forming an opening upon a first dielectric layer that is formed above a structure upon which the copper layer is formed and controlling a parameter based upon a measured thickness; nor does it read upon averaging the thickness from a plurality of sites on a copper layer, as called for by claims of the present invention. Additionally, as described in further details herein, other art cited by the Examiner does not provide disclosure sufficient to make obvious all of the elements of the claims of the present invention that are not disclosed or suggested by ***Ritzdorf***.

In the Final Office Action Dated October 25, 2004, the Examiner stated that Appellants are attempting to show non-obviousness by attacking references individually. Appellants respectfully disagree. Appellants are not interested in attacking the prior art references individually; Appellants merely pointed to various deficits of the prior art references that are not made up for by the primary reference (***Ritzdorf***). The Examiner attempted to piece together an obviousness argument by extracting various disclosures from three separate prior art references. Appellants merely pointed out that these references have various individual deficits of subject matter, that when combined, all of the elements of claims of the present invention would not be made obvious.

Regarding U.S. Patent No. 6,221,765 (***Ueno***), in the Final Office Action Dated October 25, 2004, the Examiner stated that Appellants distorted the rejection by stating that ***Ueno*** does not disclose modifying a parameter by measuring a stress, which is an element that the Examiner uses ***Ueno*** to provide. *See*, Final Office Action Dated October 25, 2004, page 10. Then, the Examiner stated that ***Ueno*** is provided for showing why knowing the specific quantity of stress is important, which would lead one of ordinary skill in the art, based upon disclosure in ***Ritzdorf***,

to make obvious the element of "measuring a stress." Therefore, this amounts to using ***Ueno*** in combination with ***Ritzdorf*** to make obvious the element of "measuring a stress." Accordingly, Appellants are still correct in stating that the Examiner is using ***Ueno*** (in combination with ***Ritzdorf***) to provide the missing element of "measuring a stress". Hence, Appellants respectfully assert that Appellants did not distort the rejection provided.

Contrary to the Examiner's assertion (in the Final Office Action Dated October 25, 2004), ***Ueno*** does not show why knowing the specific quantity of stress in a copper layer is important, ***Ueno*** merely points out that residual tensile stress may be present and makes a guess that the stress may be the result of shrinking of a plating film. *See*, col. 3, lines 33-37. Simply because ***Ueno*** describes a guess as to why residual tensile stress is present and because ***Ritzdorf*** discloses "other parameters" being measured, it does not follow that cited prior art provides sufficient motivation to one of ordinary skill in the art to measure a stress parameter (along with other elements of claims of the present invention). Therefore, Appellants' argument that ***Ueno*** does not provide sufficient motivation or incentive to make obvious the element of "measuring a stress" still holds true. Furthermore, Appellants submit that one skilled in the art would not make obvious the element of "measuring a stress" in the context of claims of the present invention simply because ***Ueno*** merely discloses that tensile stress may occur as a result of shrinkage of plating film, and simply because ***Ritzdorf*** merely discloses film thickness along with "other measurements"; the combination of which does not make obvious varying a parameter in response to thickness differing from desired thickness and mechanical stress. There is no evidence presented to the contrary. Additionally, even if ***Ritzdorf*** and ***Ueno*** were combined with ***Breiner***, this element of the present invention would still not be made obvious.

Regarding ***Breiner***, in the Final Office Action Dated October 25, 2004, the Examiner asserts that Appellants' arguments regarding ***Breiner*** are based upon a false premise. *See*, page 10 of the Final Office Action Dated October 25, 2004. Appellants respectfully disagree. The Examiner makes this assertion by agreeing with Appellants that the number of points referenced in ***Breiner*** refers to the number of positions in the fabrication process, and not to the number of points on the semiconductor wafer itself; and adds that ***Breiner*** also states that the data may include multiple measurements of each point. However, Appellants respectfully assert that this disclosure in ***Breiner*** does not contradict Appellants' contentions. The disclosure of multiple measurements for each data point in ***Breiner*** does not refer to averaging a plurality of thicknesses from a plurality of locations on a copper layer, as called for by claims of the present invention (see Col. 4, lines 62-63); instead, it refers to more than one measurement of "each data point". This disclosure in ***Breiner*** is preceded by a phrase that supports Appellants' argument. The term "mean value" is put into context by the preceding phrase "multiple measurements for each data point," which suggests a mean or median value for the multiple measurements for each data point and *not* to the same measurements of different data points [emphasis added] (see, col. 4, lines 61-65). Hence, ***Breiner***, along with the cited prior art, does not make obvious the element of averaging a plurality of thicknesses from a plurality of locations on a copper layer, as called for by claims of the present invention.

Additionally, in the Final Office Action Dated October 25, 2004, the Examiner stated that Appellants' description of the term "wafer map" is based upon a false premise. *See*, page 11 of the Final Office Action Dated October 25, 2004. Appellants respectfully disagree. When reading the disclosure of ***Breiner*** in proper context, the term "wafer map" in ***Breiner*** indeed refers to a reference electrical testing, and the Examiner does not offer any evidence to the

contrary. The term "wafer map" is <u>*specifically separated*</u> to discuss electrical testing and refers to electrical test characteristics, such as breakdown voltages, leakage currents, resistivity, *etc.*, (emphasis added). ***Breiner*** discloses using such data to provide a wafer map relating to electrical responses related to the geography of the semiconductor wafer (see item numbers 8 and 9 on col. 4, lines 48-59). There is no evidence in any of the cited prior art references to suggest or make obvious a wafer map relating to the thickness across various portions of the semiconductor wafer. These arguments are provided in more detail below.

Appellants respectfully assert that ***Ritzdorf*** in combination with ***Ueno*** and ***Breiner*** does not disclose or make obvious all of the elements of claim 1 of the present invention. ***Ritzdorf*** does not teach, disclose, or make obvious, all of the elements of claim 1, 7-12, and 22. ***Ritzdorf*** is directed towards a system for receiving a wafer for processing, *e.g.*, electrical chemical plating. ***Ritzdorf*** discloses forming a seed layer upon a wafer and transporting the wafer for further analysis or processing. *See,* col. 9, lines 52-55, col. 10, lines 14-16. However, ***Ritzdorf*** does not disclose forming an opening upon a first dielectric layer that is formed above a structure upon which the copper layer is formed and controlling a parameter based upon a measured thickness as called for by independent claims 1 and 22 of the present invention.

Furthermore, ***Ritzdorf*** does not disclose averaging the thickness from a plurality of sites on a copper layer as called for by claims 1 and 22 of the present invention. Controlling a parameter in response to the thickness data that is averaged from data relating to a plurality of positions are not taught by ***Ritzdorf*** and this deficit is not made up for by ***Ueno*** and/or ***Breiner***. Additionally, neither ***Ritzdorf***, ***Ueno***, nor ***Breiner*** disclose measuring a mechanical stress

relating to the first copper layer and varying a parameter to form the first copper layer in response to the actual thickness differing from the desired thickness and the mechanical stress.

The Examiner cites ***Ueno*** to disclose the mechanical stress element of claims 1 and 22. However, ***Ueno*** merely discloses a compressive stress being generated in a film to allow a stress to act in a direction enhancing shrinkage of the plating film. *See,* col. 3, lines 33-37. The plating film disclosed in ***Ueno*** is formed while distorting the semiconductor substrate into a concave. *See,* col. 3, lines 37-39. Therefore, the plating film, in which the compressive stress is generated, is formed in an attempt to prevent void generation. *See,* col. 3, lines 39-47. However, measuring the mechanical stress of a copper layer to modify a parameter used to form the copper layer is not disclosed by ***Ueno***. The compression stress applied by ***Ueno*** is merely performed to prevent void generation. The Examiner uses ***Ueno*** to disclose the missing element of modifying a parameter by measuring a stress, which is indeed not provided by ***Ueno***.

Ueno is merely directed to distorting the semiconductor substrate into a concave to introduce compressive stress to prevent void generation. Therefore, one skilled in the art would not combine the disclosure of ***Ueno*** with ***Ritzdorf*** to call for or make obvious the element of measuring the mechanical stress and varying the parameter based upon the actual thickness differing from the desired thickness and the mechanical stress as called for by claims 1 and 22 of the present invention. Furthermore, even with the combination of ***Ueno***, elements other than measuring the mechanical stress are missing from the combination of ***Ueno*** with ***Ritzdorf***, and ***Breiner*** does not make up for this deficit, as described below.

Appellants respectfully assert that the term "multiple measurements for each data point," in ***Breiner***, as used by the Examiner, does not refer to a plurality of measurements at different points on a semiconductor wafer. The evidence and reasoning for support of this assertion is provided below. When examining this phrase, one skilled in the art would not ignore the disclosure in ***Breiner*** that actually sheds light to this phrase. As disclosed in ***Breiner***, the "number of points" reference in ***Breiner*** refers to the number of positions in the fabrication process, not the number of points on the semiconductor wafer itself (the evidence for supporting this statement is in col. 4, lines 14-15). Additionally, the term "wafer map" is specifically separated to discuss electrical testing and refers to electrical test characteristics, such as breakdown voltages, leakage currents, resistivity, *etc.* ***Breiner*** discloses using such data to provide a wafer map relating to electrical responses related to the geography of the semiconductor wafer (see item numbers 8 and 9 on col. 4, lines 48-59). Nothing in ***Breiner***, or in the other cited prior art, suggests a wafer map relating to the thickness across various portions of the semiconductor wafer.

Although ***Breiner*** discloses wafer thickness, ***Breiner*** actually points to using wafer maps for electrical testing. ***Breiner*** intentionally omits the discussion of wafer maps when discussing other types of data, such as deposition data, etch data, photolithography data, CMP data, and implant data (see items listed on col. 4, lines 18-59). In a parallel list that discusses various types of data, ***Breiner*** intentionally leaves out the term "wafer map" when discussing all items, except for discussions of the electrical test. Therefore, ***Breiner*** actually suggests only using wafer maps for electrical type data. Therefore, ***Breiner*** actually teaches away from the claimed invention.

Additionally, ***Breiner*** only provides a passing reference to a "mean" value of data points, as described above, ***Breiner*** does not disclose measuring the thickness of copper layers at a plurality of locations on the copper layer and averaging the resultant data, as called for by the claims of the present invention. Again, the term "mean value" is put into context by the preceding term "multiple measurements for each data point," which suggests a mean or median value for the multiple measurements for each data point and not to the same measurements of different data points (see, col. 4, lines 61-65). Furthermore, claims 1 and 22 (Group I claims) also call for measuring a mechanical stress and modifying a parameter relating to forming a copper layer, which is not disclosed or made obvious by the cited prior art. Support for these amendments may be found in the specification, for example, see page 12 of the specification. Therefore, ***Breiner*** clearly does not disclose or make obvious all of the elements of the claimed invention. Accordingly, combining ***Ritzdorf***, ***Ueno,*** and ***Breiner***, still would not make obvious all of the elements of claims 1 and 22 of the present invention. Therefore, for at least the reasons cited above, claims 1 and 22 (Group I claims) are allowable.

Independent claims 1 and 22, are allowable for at least the reasons cited above. Additionally, dependent claims 7-9 (Group II claims) and claims 10-12 (Group III claims), which depend from independent claim 1, are also allowable for at least the reasons cited above.

B. Claims 1, 7, 8, 10, 11, and 22 are not anticipated or made obvious by U.S. Patent No. 6,428,673 (*Ritzdorf*) in view of U.S. Patent No. 6,221,765 (*Ueno*) and U.S. Patent No. 6,211,094 (*Jun*) pursuant to 35 U.S.C. § 103(a).

Groups I, II, and III (Claims [1 & 22], [7-9], and [10-12], respectively) are allowable

Appellants respectfully assert that the Examiner did not meet the legal standards (described in Part A of this section) to reject claims 1, 7, 8, 10, 11, and 22 under 35 U.S.C. § 103(a), including because of the fact that the prior art references (***Ritzdorf***, ***Ueno***, and ***Jun***) does not teach or suggest all the claim limitations of claims 1, 7-12, and 22.

In the Final Office Action Dated October 25, 2004, the Examiner rejected claims 1, 7, 8, 10, 11, and 22, under 35 U.S.C. § 103(a) as being unpatentable over U.S. Patent No. 6,428,673 (***Ritzdorf***) in view of U.S. Patent No. 6,221,765 (***Ueno***) and U.S. Patent No. 6,211,094 (***Jun***). Appellants respectfully traverse this rejection. Appellants respectfully assert that the Examiner erred in rejecting claims 1, 7, 8, 10, 11, and 22, and assert that these claims are allowable.

The Examiner combines ***Ritzdorf*** and ***Ueno*** with ***Jun*** to reject claims 1, 7, 8, 10, 11, and 22; however, Appellants respectfully traverse this rejection. As described above, ***Ritzdorf*** does not disclose all of the elements of claims 1 and 22 of the present invention and the disclosure of ***Ueno*** and ***Jun*** would still not make up for this deficit. For example, as described above, ***Ritzdorf*** does not teach the averaging element or measuring of the mechanical stress to modify a parameter. The compressive stress disclosed by ***Ueno*** still does not make up for this deficit, as described above. Additionally, the Examiner cites ***Jun*** to assert obviousness of the element of averaging the plurality of thickness to form a plurality of locations. However, ***Jun*** merely discloses measurement of wafers that are analyzed for thickness at various zones. Appellants respectfully assert that ***Jun*** does not disclose averaging the plurality of thicknesses from a plurality of locations on the copper layer, as called for by claims 1 and 22 (Group I claims) of the present invention. ***Jun*** does not disclose comparing the actual thickness to a desired thickness as called for by claims 1 and 22 of the present invention. Furthermore, ***Jun*** does not disclose

measuring the mechanical stress relating to a copper layer and, as described above, this element is not disclosed or made obvious by ***Ritzdorf*** or ***Ueno.*** Therefore, adding the disclosure of ***Jun*** to ***Ritzdorf*** and/or ***Ueno*** still would not disclose or make obvious all of the elements of claims 1 and 22 (Group I claims) of the present invention. Therefore, claims 1, 7, 8, 10, 11, and 22, are not disclosed or made obvious by ***Ritzdorf, Jun, Ueno*** or their combination, for at least the reasons described above. Therefore, claims 1 and 22 (Group I claims), 7-9 (Group II claims), and 10-12 (Group III claims), are allowable for at least the reasons cited above.

Independent claims 1 and 22, are allowable for at least the reasons cited above. Additionally, dependent claims 7-9 (Group II claims) and claims 10-12 (Group III claims), which depend from independent claim 1, are also allowable for at least the reasons cited above.

In light of the arguments presented above, Appellants respectfully assert that claims 1, 7-12 and 22 are allowable. In light of the arguments presented above, a Notice of Allowance is respectfully solicited.

In view of the foregoing, it is respectfully submitted that the Examiner erred in not allowing all claims pending in the present application, claims 1, 7-12 and 22, over the prior art of record. In view of the foregoing remarks, Appellants respectfully request that the Board of Patent Appeals and Interferences reverse the decision rejecting claims 1-22, and direct the Examiner to pass the case to issue.

The undersigned attorney may be contacted at (713) 934-4069 with respect to any questions, comments, or suggestions relating to this appeal.

Date: September 8, 2005	Respectfully submitted, WILLIAMS, MORGAN & AMERSON, P.C. CUSTOMER NO. 23720 By: ______________________ Jaison C. John, Reg. No. 50,737 10333 Richmond, Suite 1100 Houston, Texas 77042 (713) 934-7000 (713) 934-7011 (facsimile) ATTORNEY FOR APPELLANTS

VIII. CLAIMS APPENDIX

1. (Previously Presented) A method comprising:

forming a first dielectric layer above a first structure layer;

forming a first opening in the first dielectric layer;

forming a first copper layer above the first dielectric layer and in the first opening; and

measuring an actual thickness of the copper layer, measuring the actual thickness comprises averaging a plurality of thicknesses from a plurality of locations on said first copper layer;

comparing the actual thickness to a desired thickness;

measuring a mechanical stress relating to said first copper layer;

varying at least one parameter used to form the first copper layer in response to the actual thickness differing from the desired thickness and said mechanical stress.

2. (Withdrawn) The method of claim 1, wherein forming the first dielectric layer comprises forming the first dielectric layer using a dielectric material having a dielectric constant K of at most about four, and forming the first dielectric layer using at least one of a chemical vapor deposition (CVD) process, a low pressure CVD (LPCVD) process, a plasma enhanced CVD (PECVD) process, a sputtering process, a physical vapor deposition (PVD) process, and a spin on coating process.

3. (Withdrawn) The method of claim 1, wherein forming the first opening in the first dielectric layer comprises forming the first opening in the first dielectric layer using one of a

mask of photoresist and an etch stop layer, the one of the mask of photoresist and the etch stop layer being formed and patterned above the first dielectric layer.

4. (Withdrawn) The method of claim 3, wherein using the one of the mask of photoresist and the etch stop layer comprises using the etch stop layer being formed of silicon nitride.

5. (Withdrawn) The method of claim 1, wherein forming the copper layer comprises forming the copper layer using electrochemical deposition of copper.

6. (Withdrawn) The method of claim 5, wherein using the electrochemical deposition of the copper comprises forming at least one barrier layer and a copper seed layer in the first opening before the electrochemical deposition of the copper.

7. (Original) The method of claim 1, wherein measuring the actual thickness of the copper layer further comprises measuring the actual thickness of the copper layer at a plurality of locations.

8. (Original) The method of claim 7, wherein measuring the actual thickness of the copper layer at a plurality of locations further comprises averaging the plurality of measurements of the actual thickness.

9. (Original) The method of claim 7, wherein measuring the actual thickness of the copper layer at a plurality of locations further comprises selecting a median measurement as the actual thickness.

10. (Original) The method of claim 7, wherein comparing the actual thickness to the desired thickness further comprises comparing the desired thickness to each of the plurality of measured thickness.

11. (Original) The method of claim 8, wherein comparing the actual thickness to the desired thickness further comprises comparing the desired thickness to the averaged measured thickness.

12. (Original) The method of claim 9, wherein comparing the actual thickness to the desired thickness further comprises comparing the desired thickness to the median thickness.

13. (Withdrawn) The method of claim 1, wherein forming the first copper layer further comprises electroplating the first copper layer above the first dielectric layer and in the first opening.

14. (Withdrawn) The method of claim 13, wherein varying at least one parameter used to form the first copper layer in response to the actual thickness differing from the desired thickness further comprises varying an amount of time that the first copper layer is electroplated above the first dielectric layer and in the first opening.

15. (Withdrawn) The method of claim 14, wherein varying at least one parameter used to form the first copper layer in response to the actual thickness differing from the desired thickness further comprises increasing the amount of time that the first copper layer is electroplated above the first dielectric layer and in the first opening in response to the desired thickness being greater than the actual thickness.

16. (Withdrawn) The method of claim 14, wherein varying at least one parameter used to form the first copper layer in response to the actual thickness differing from the desired thickness further comprises decreasing the amount of time that the first copper layer is electroplated above the first dielectric layer and in the first opening in response to the desired thickness being less than the actual thickness.

17. (Withdrawn) The method of claim 13, wherein varying at least one parameter used to form the first copper layer in response to the actual thickness differing from the desired thickness further comprises varying at least one of a current and voltage applied to an anode while electroplating the layer of copper above the first dielectric layer and in the first opening.

18. (Withdrawn) The method of claim 17, wherein varying at least one of a current and voltage further comprises increasing at least one of the current and voltage while the first copper layer is electroplated above the first dielectric layer and in the first opening in response to the desired thickness being greater than the actual thickness.

19. (Withdrawn) The method of claim 17, wherein varying at least one of a current and voltage further comprises decreasing at least one of the current and voltage while the first copper layer is electroplated above the first dielectric layer and in the first opening in response to the desired thickness being less than the actual thickness.

20. (Withdrawn) The method of claim 17, wherein varying at least one of the current and voltage further comprises varying the frequency of at least one of the current and voltage.

21. (Withdrawn) The method of claim 17, wherein varying at least one of the current and voltage further comprises varying the magnitude of at least one of the current and voltage.

22. (Previously Presented) A system, comprising:

means for forming a first dielectric layer above a first structure layer;

means for forming a first opening in the first dielectric layer;

means for forming a first copper layer above the first dielectric layer and in the first opening;

means for measuring an actual thickness of the copper layer, measuring the actual thickness comprises averaging a plurality of thicknesses from a plurality of locations on said first copper layer;

means for comparing the actual thickness to a desired thickness;

means for measuring a mechanical stress relating to said first copper layer;

means for varying at least one parameter used to form the first copper layer in response to the actual thickness differing from the desired thickness and said mechanical stress.

23. (Withdrawn) A system, comprising:

an electroplate tool capable of depositing a layer of copper above a surface of a semiconductor device, said electroplate tool having at least one parameter that may be varied to control a thickness of the layer of copper;

a metrology tool capable of measuring the thickness of the copper layer and delivering a signal indicative thereof; and

a controller adapted for receiving the signal, comparing the measured thickness to a desired thickness, and varying the at least one parameter in response to the measured thickness differing from the desired thickness.

24. (Withdrawn) The system of claim 23, wherein the controller varying the at least one parameter further comprises the controller varying an amount of time that the first copper layer is electroplated above the surface of the semiconductor device.

25. (Withdrawn) The system of claim 24, wherein the controller further comprises the controller being adapted for increasing the amount of time that the first copper layer is electroplated above the surface of the semiconductor device in response to the desired thickness being greater than the actual thickness.

26. (Withdrawn) The system of claim 24, wherein the controller further comprises the controller being adapted for decreasing the amount of time that the first copper layer is electroplated above the surface of the semiconductor device in response to the desired thickness being less than the actual thickness.

27. (Withdrawn) The system of claim 23, wherein the controller further comprises the controller being adapted for varying at least one of a current and voltage applied to an anode of the electroplate tool while electroplating the layer of copper above the surface of the semiconductor device.

28. (Withdrawn) The system of claim 27, wherein the controller further comprises the controller being adapted for increasing at least one of the current and voltage while the first copper layer is electroplated above the surface of the semiconductor device in response to the desired thickness being greater than the actual thickness.

29. (Withdrawn) The system of claim 27, wherein the controller comprises the controller being adapted for decreasing at least one of the current and voltage while the first copper layer is electroplated above the surface of the semiconductor device in response to the desired thickness being less than the actual thickness.

30. (Withdrawn) The system of claim 27, wherein the controller further comprises the controller being adapted for varying the frequency of at least one of the current and voltage.

31. (Withdrawn) The system of claim 27, wherein the controller further comprises the controller being adapted for varying the magnitude of at least one of the current and voltage.

IX. EVIDENCE APPENDIX

In response to Examiner's request in the Final Office Action dated June 8, 2005, copies of the Rudolph Metrology Tool discussed in previous Office Actions and Responses are provided herein. *See* "Operating Your *Meta*Pulse™ System, Part No. A16203, Rudolph Technologies, Inc., 4/22/98; and *Meta*Pulse ™ Administrator's Guide, Part No. A17945, Revision A, Rudolph Technologies, Inc., 4/22/98.

X. RELATED PROCEEDINGS APPENDIX

There are no related appeals and/or interferences that might affect the outcome of this proceeding.

Operating Your

*Meta*PULSE™ System

Part No. A16203
4/22/98

RUDOLPH
Technologies, Inc.
One Rudolph Road, P.O. Box 1000
Flanders, NJ 07836

DISCLAIMER

Every attempt has been made to make this manual complete, accurate, and current. Users are cautioned, however, that Rudolph Technologies, Inc. reserves the right to make improvements and changes without notice and shall not be responsible for any damages (including consequential) caused by reliance on the material presented, including, but not limited to, typographical, arithmetical, or listing errors.

Revision History

This page provides a revision history for this manual.

Pages Affected	Revision	Date	Reason
All		4/22/98	Original release covering basic operating instructions for *Meta*PULSE 200 and 300 systems.

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About This Guide

Introduction

This guide provides detailed information on how to select a recipe and perform wafer measurements using the *Meta*PULSE System Operator program in Run Mode.

Brief descriptions of each section of this manual are provided below:

<u>About This Guide</u>

Describes the purpose, structure, and intended audience of this guide.

<u>Chapter 1 — System Overview</u>

Provides an overview of the *Meta*PULSE System hardware.

<u>Chapter 2 — Running Recipes</u>

Describes the views available when in Run Mode. Procedures are provided for: setting up and running a cassette of wafers, viewing the wafer currently being measured, and accessing measurement data that was generated for the current run.

<u>Appendix A — Starting and Stopping the System</u>

Describes how to start up and shut down the *Meta*PULSE System and software. Procedures are provided for normal start up and shut down, extended shutdown, and for emergency shut down and recovering from an emergency shut down. Starting the *Meta*PULSE Operator program and logging into the system are also covered.

<u>Appendix B — Menu Maps</u>

Provides menu maps for the *Meta*PULSE System Operator program in Run Mode.

<u>Appendix C — Getting Help</u>

Provides basic troubleshooting and problem resolution procedures, and information on how to contact Rudolph Technologies for support.

<u>Glossary</u>

Provides definitions of commonly used terms.

Intended Audience

This guide is mainly intended for the **Operators** who are responsible for performing the actual wafer measurements using recipes that were previously created by **Process Engineers**.

Related Manuals

Other relevant Rudolph publications include:

- ***Meta*PULSE™ Applications Development Guide** (Part Number A17944). Provides detailed information on how to create, test, and modify filmstacks and recipes that are used to measure wafers. Describes saving, retrieving, and manipulating measurement data, and how to edit the recipe database.
- ***Meta*PULSE™ Administrator's Guide** (Part Number A17945). Provides detailed information on how to configure your *Meta*PULSE System, setup system security, perform database operations (such as backup and restore), and perform basic preventive maintenance.
- ***Meta*PULSE™ 200 System Facility Requirements Manual** (Part Number A15984). Describes considerations that need to be addressed prior to shipment and installation of a *Meta*PULSE 200 System.
- ***Meta*PULSE™ 300 System Facility Requirements Manual** (Part Number A17116). Describes considerations that need to be addressed prior to shipment and installation of a *Meta*PULSE 300 System.
- **VANGUARD™ SECS-II/GEM Interface Specifications** (Part Number A17792). Describes the SECS-II/GEM interface.
- Additional documentation as provided by Rudolph Technologies.

Usage and Conventions

The following table shows some of the conventions used in this guide.

Term or Phrase	Meaning
***Meta*PULSE** or **System**	Unless otherwise specified, the terms "*Meta*-PULSE" and "System" are intended to refer to both the *Meta*PULSE 200 and *Meta*PULSE 300 System.
Bold	Bold text identifies menu or field names (for example, **Mode** menu or **Name** field) and any other text that may require particular attention.
[Bold]	Bold text within square brackets identifies window buttons (for example, click on **[Enter]**).
Click or **Select**	These terms imply a single press and release of the LEFT button on the pointing device (mouse or trackball) with the cursor positioned over the specified object (for example, select the desired filmstack from the list then click on **[Enter]**).
Double Click	Unless otherwise stated, this term implies the press and release of the LEFT button on the pointing device twice in quick succession with the cursor positioned over the specified object.
Right Click	This term implies a single press and release of the RIGHT button on the pointing device.
View or **Window**	The terms "View" and "Window" are used interchangeably in this guide and refer to a window that is displayed on the system monitor.
Cassette Plate or **Load Port**	The terms "Cassette Plate" and "Load Port" are used interchangeably in this guide.

Admonishments

Admonishments are used to make certain information stand out from the surrounding text in order to be brought to your attention. Special attention should be paid to the following types of admonishments used in this guide:

- Notes
- Cautions
- Warnings
- Security Notices

Notes

Notes provide important or explanatory information that stands out from the rest of the text. Notes are presented in the following manner:

NOTE

For security reasons, asterisks (*) will be displayed as you enter your password.

Cautions

Cautions indicate the presence of a hazard that will or can cause property damage (such as equipment damage, loss of software/data, or service interruption) if the hazard is not avoided. Cautions are presented in the following manner:

CAUTION

Modifying an existing transfer control will affect all recipes that use that transfer control.

Warnings

Warnings indicate the presence of a hazard that will or can cause personal injury if the hazard is not avoided. Warnings are presented in the following manner:

WARNING

Potentially hazardous voltages may be present in the *Meta*PULSE System and Chiller Module. Failure to follow proper safety precautions may result in serious personal injury or death. Electrical problems should be referred to qualified electricians or Rudolph Technologies support personnel.

Security Notices

Security notices indicate a procedure or condition that could impact the security of the recipe database or measurement data.

SECURITY NOTICE

To maintain system security, it is important to remember to log out of the system when you have completed your tasks. Failure to do so may allow unauthorized users to have access to the recipe database and measurement data.

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System Overview

Chapter 1

Introduction

This chapter illustrates the major hardware components that make up the *Meta*PULSE 200 and *Meta*PULSE 300 System, and is intended to be a high level overview of the *Meta*PULSE System. Detailed operating instructions are provided in later sections of this manual.

The topics covered in this chapter include:

Hardware Overview

The sections that follow illustrate the main hardware components that make up a *Meta*PULSE 200 and *Meta*PULSE 300 System.

*Meta*PULSE 200

The *Meta*PULSE 200 System is designed to be operated in a ballroom configuration. The major assemblies that make up the *Meta*PULSE 200 System are shown in Figure 1-1.

An external Chiller Module provides cooling water for the *Meta*PULSE laser. The Chiller Module is shown in Figure 1-4 on page OP 1–5.

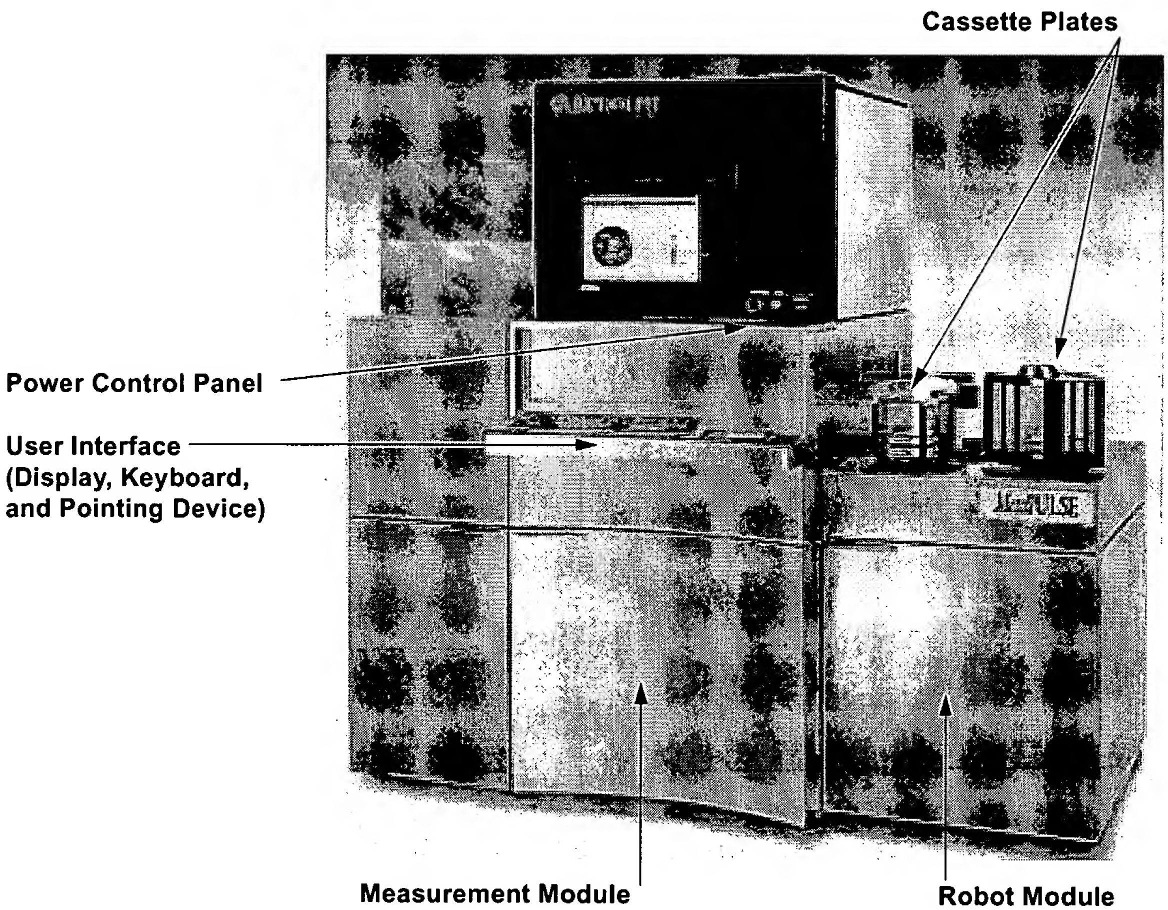


Figure 1-1. *Meta*PULSE 200 System

*Meta*PULSE 300

The *Meta*PULSE 300 System is designed to be operated in either a ballroom or through-wall configuration. The major assemblies that make up the *Meta*PULSE 300 System are shown in Figure 1-2 and Figure 1-3.

An external Chiller Module provides cooling water for the *Meta*PULSE laser. The Chiller Module is shown in Figure 1-4 on page OP 1–5.

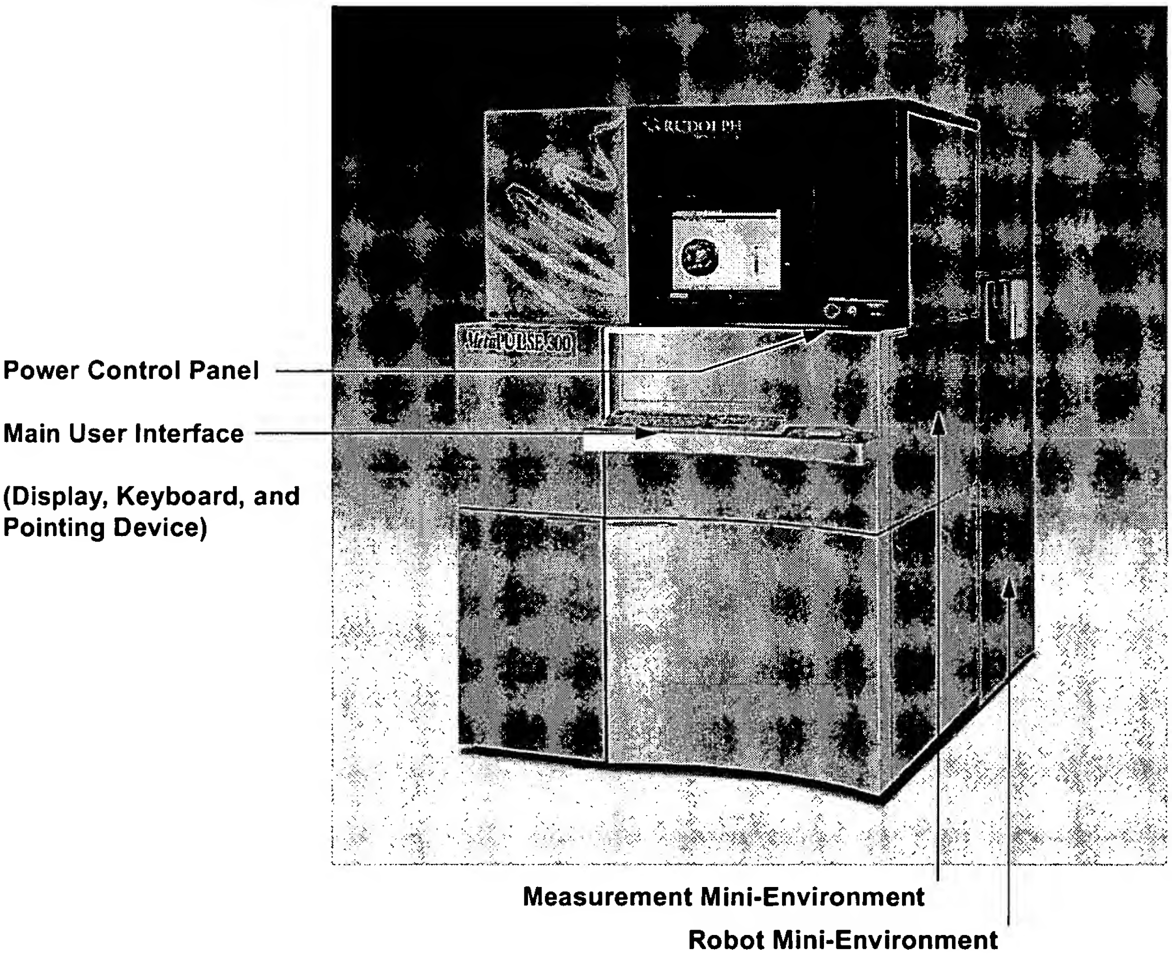


Figure 1-2. *Meta*PULSE 300 System — Chase Side (Rear)

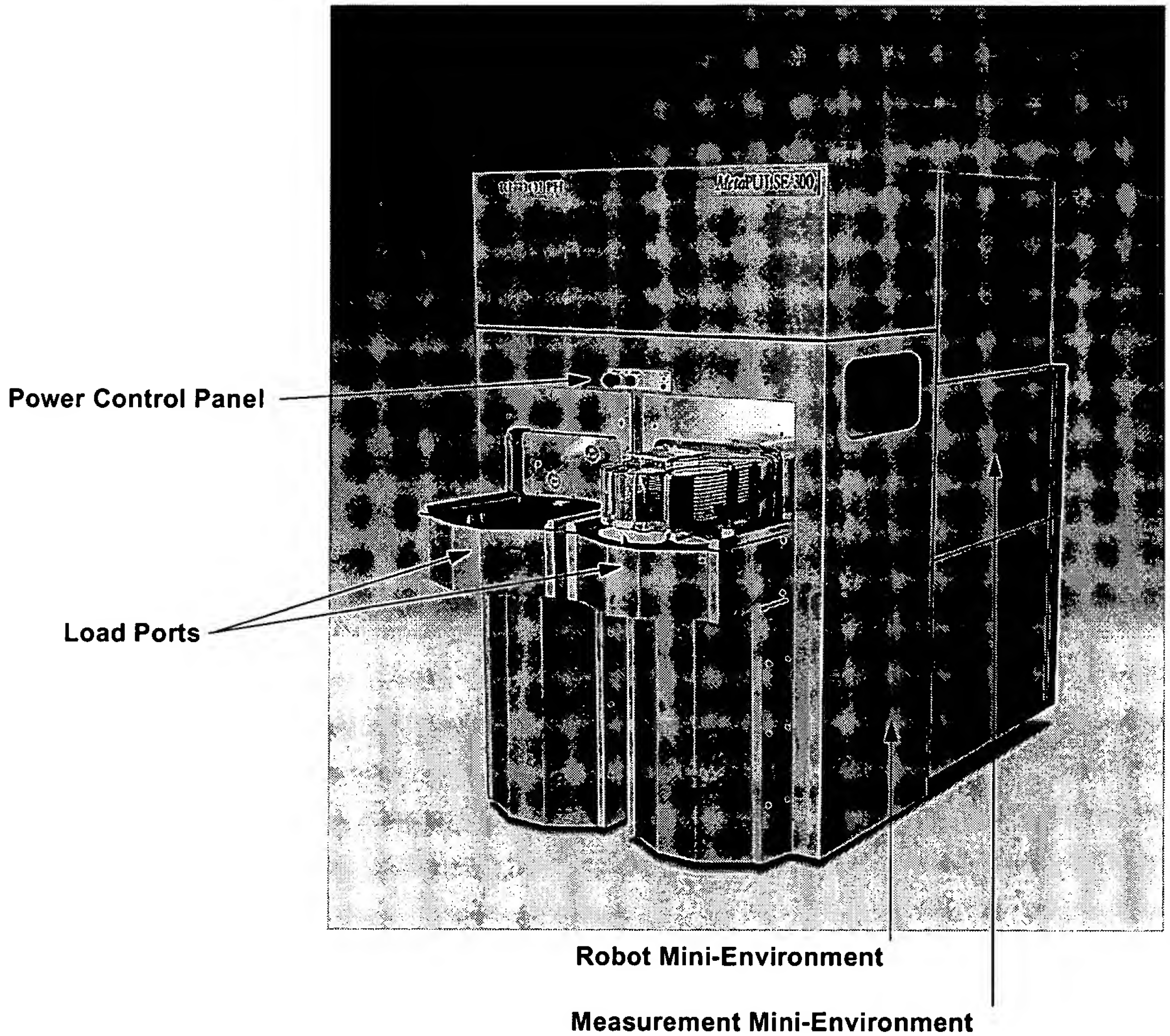


Figure 1-3. ***Meta*PULSE 300 System — Cleanroom Side (Front)**

Chiller Module

The external Chiller Module, used by both *Meta*PULSE 200 and *Meta*PULSE 300 Systems, is a closed loop water recirculator used to stabilize the temperature of the ultrafast laser.

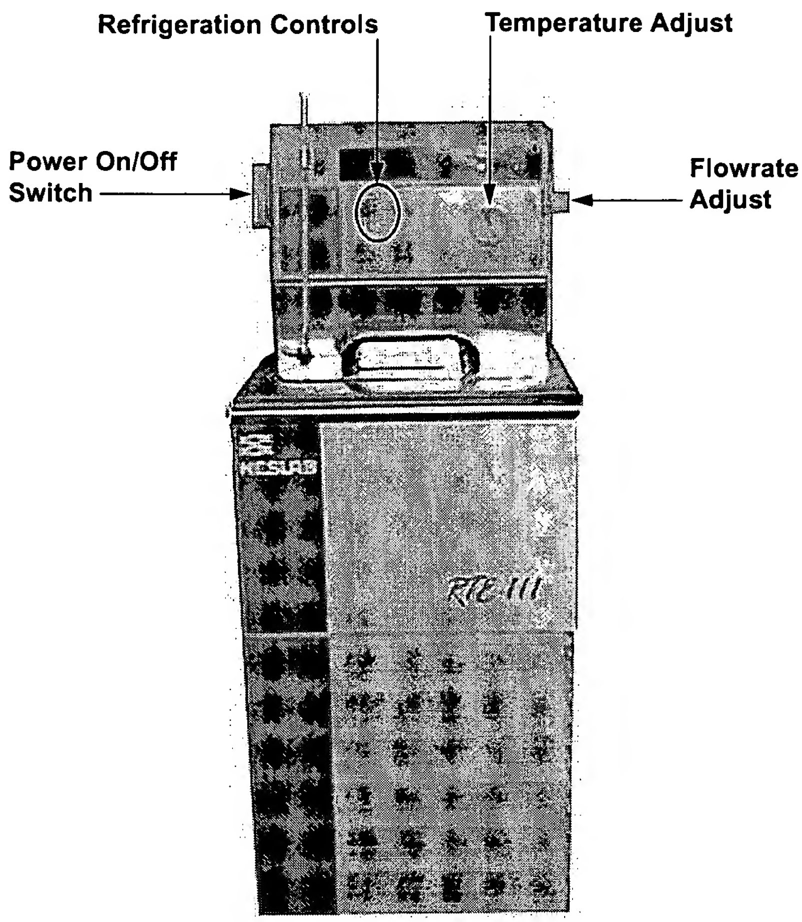


Figure 1-4. Chiller Module

System Safety Features

Each *Meta*PULSE System provides the following safety mechanisms:

- **Laser Safety.** *Meta*PULSE Systems meet or exceed all requirements of U.S. Federal Regulation 21CFR1040.00 for a Class I laser product when all doors and access panels to the Measurement Module are closed. No special measures are required to protect the operator from laser radiation under normal operating conditions.

  In certain maintenance modes, service personnel may have access to a Class IV laser product and will need appropriate protective materials. Laser warning labels (shown below) are affixed at several locations on the *Meta*PULSE System:

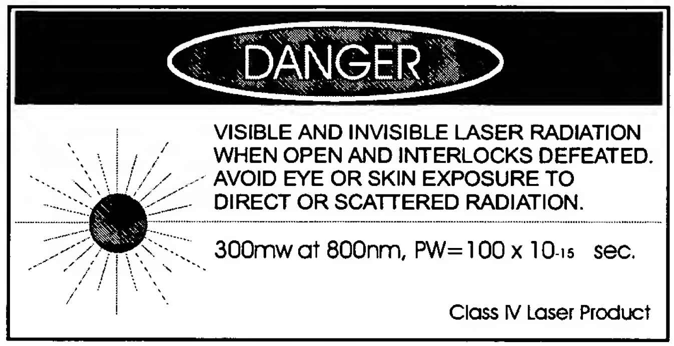


Figure 1-5. Laser Safety Label

NOTE

If special safety modifications are required to comply with international safety standards, please provide Rudolph Technologies with a detailed description of the specific safety requirements. The requirements must be communicated to, and accepted by, Rudolph Technologies prior to placing your final order.

- **Motion and Laser Interlocks.** Several interlocks are built into the *Meta*PULSE System to ensure operator safety.

- **Emergency Shutoff Forces.** An emergency shutoff function is built into the *Meta*PULSE System wafer-handling robot. All robot motion is automatically stopped if an obstacle is encountered.

- **Emergency Off.** An Emergency Off (EMO) switch shuts down the entire system including air flow and the computer. Pilot voltage and the laser internal UPS are not shut down. *Meta*PULSE 200 Systems have one EMO switch located to the right of the VGA display. *Meta*PULSE 300 Systems have two EMO switches, one located on the front and one located on the rear of the unit.

Running Recipes

Chapter 2

Introduction

This chapter describes how to use the *Meta*PULSE System Operator program in Run Mode. In this mode, you will select and run the measurement recipes that were created by the Process Engineer in Recipe Creation Mode.

The topics covered in this chapter include:

NOTE

It is assumed that the reader has a basic knowledge and understanding of a computer graphical user interface and the basic functionality and use of a trackball/mouse pointing device.

The Measurement Process

The *Meta*PULSE System is capable of measuring both patterned and unpatterned wafers.

The Operator selects a Folder, Subfolder, Cassette recipe, and load port, and then presses the **[Start Process]** button on the Action Bar to start the measurement process. The *Meta*PULSE System then performs the normal wafer load, centering, and flat/notch routines.

In a non-pattern recognition recipe, once the wafer is centered and the flat/notch is found, the *Meta*PULSE System immediately begins performing measurements on the programmed locations.

In a pattern recognition recipe, after the wafer is centered and the flat/notch is found, the pattern recognition system registers the wafer by searching for two registration points that were previously trained by the Engineer when the recipe was created. Once the sites are found, the system proceeds to the specified site on each selected die to measure the selected sites.

The display in the Wafer View Window is slightly different during operation for a pattern recognition versus a non-pattern recognition recipe:

- For pattern recognition recipes, the Wafer View Window displays a simulated map of the chip and measurement sites on the wafer. In the Site Locator Window, vision measurement sites are represented by squares. Non-pattern recognition sites are represented by an "X".

  When the system moves to a site, a box appears at the site's predicted location. Once the pattern recognition system corrects the position, a blue diamond separates from the box showing the difference between the predicted location (box) and the measurement location (blue diamond).

- For non-pattern recognitions, the Wafer View Window shows only a graphic representation of the unpatterned wafer. Measurement sites are indicated by "spots" on the wafer graphic. The site currently being measured is represented by a red spot.

Run Mode Operator Windows

There are two main views (or windows) that are used when the *Meta*-PULSE Operator program is in Run Mode: the **Cassette Run View** and the **Wafer View**.

The following sections provide descriptions of each window that makes up the *Meta*PULSE Operator program Run Mode.

Cassette Run View

The Cassette Run View displays the load port status, and allows you to setup and run a cassette of wafers.

An example of the Cassette Run View is shown in Figure 2-1. Descriptions of the various parts of the screen follow the figure.

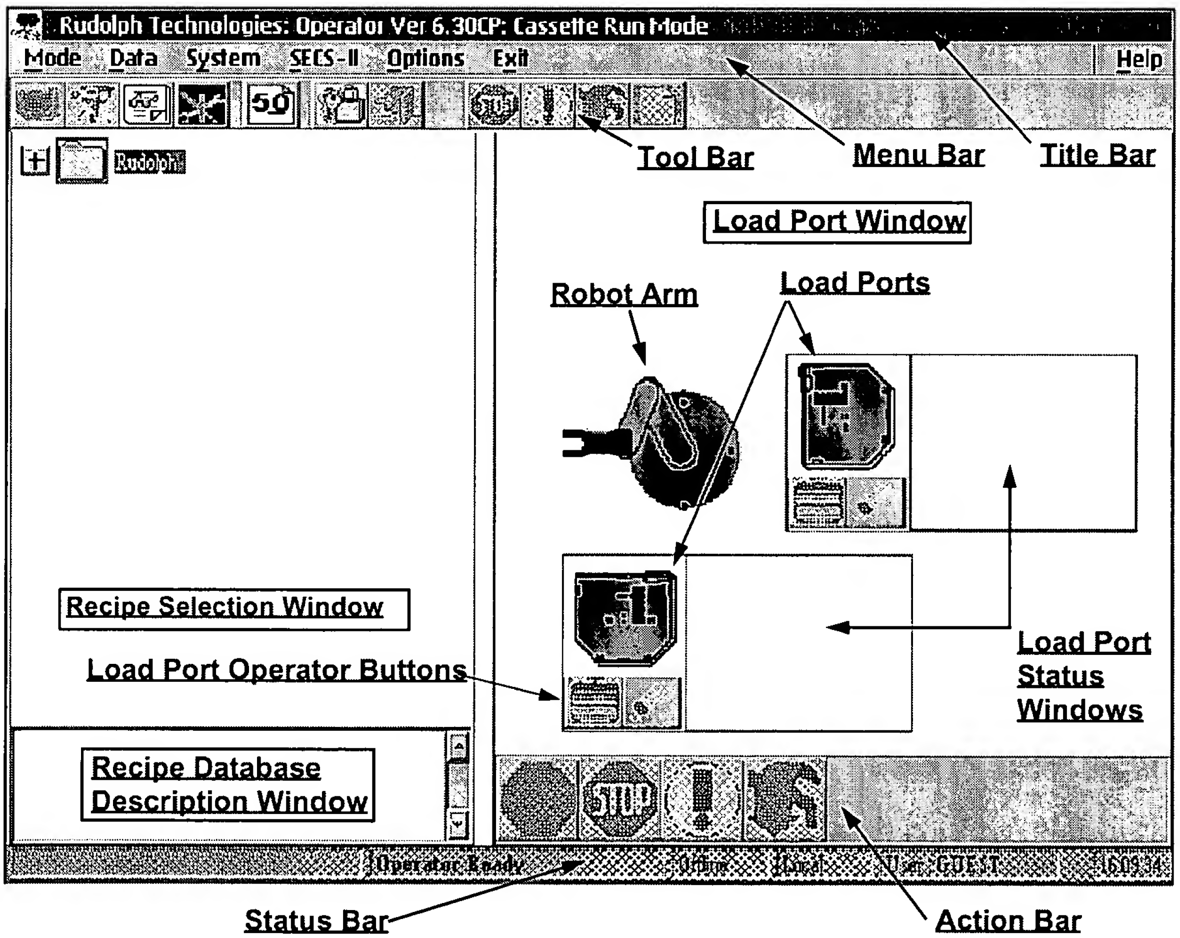


Figure 2-1. Cassette Run View Components

Recipe Selection Window

The Recipe Selection Window displays the recipe database in a tree-like structure. You will navigate this tree in order to select the Cassette recipe that you wish to run.

The recipe database is made up of Folders, Subfolders, and Cassette recipes, as well as the transfer controls, wafer recipes, and recipe controls that make up the Cassette recipes, and the materials used in the wafer recipes.

SECURITY NOTICE

The recipe database is protected by system security. The items you are allowed to select, and the functions you are allowed to perform, are dependent upon the security configuration of your system, and the permission levels granted to your login.

When in Run Mode, only Folders, Subfolders, and Cassette recipes are available in the Recipe Selection Window. Table 2-1 provides descriptions of each of the available items:

Table 2-1. Recipe Database Item Definitions (Run Mode)

Database Item	Icon	Description
Folder		A grouping of Subfolders, a Folder may be thought of as the equivalent of a Directory. All Folders in the Recipe Selection Window must be uniquely named (typically to reflect the User/Group).
Subfolder		A grouping of the available Cassette recipes, a Subfolder may be thought of as the equivalent of a Subdirectory. All Subfolders contained within the same Folder must be uniquely named (typically to reflect the type of process).
Cassette recipe		Contains the instructions to run a cassette of wafers. The instructions include the wafer recipe(s), transfer, and the recipe control used to measure the cassette. All Cassette recipes contained within the same Subfolder must be uniquely named (typically to reflect the type of recipe). Cassette recipes are the only executable item within the recipe database.

Figure 2-2 shows an example of the Recipe Selection Window Folder/Subfolder/Cassette recipe tree.

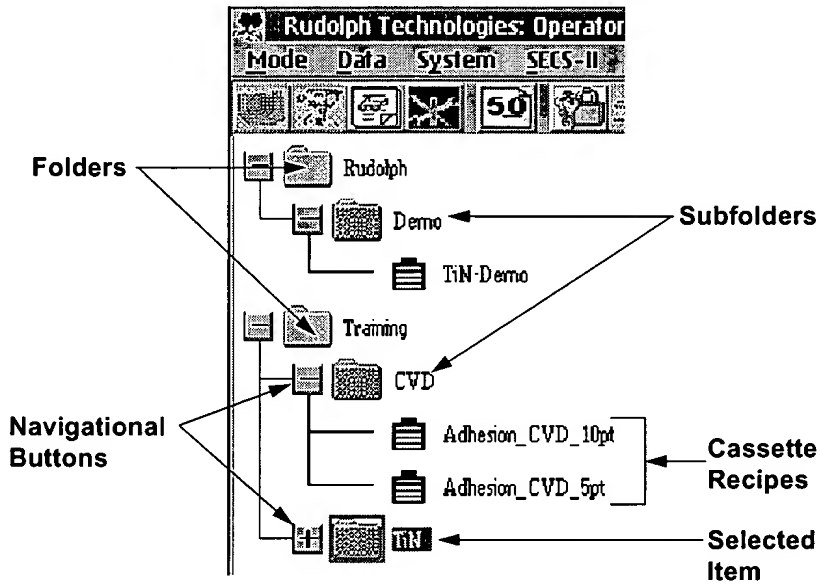


Figure 2-2. Recipe Selection Window (Partial View)

The following actions apply to the Recipe Selection Window:

- Click on an item to select (highlight) that item. Highlighed items appear in gray.
- Double click on an item to expand an item that is collapsed, or to collapse an item that is expanded (Folders and Subfolders only).

Table 2-2 provides an explanation of the buttons that are available for navigating the recipe database tree structure.

Table 2-2. Recipe Tree Navigational Buttons

Button	Meaning
	Indicates that this particular branch of the tree can be expanded. Click on the symbol (or double click on the item name) to expand the branch.
	Indicates that this particular branch of the tree is already expanded. Click on the symbol (or double click on the item name) to collapse the branch.
If neither button is displayed, then that particular branch of the tree has no sub-levels and cannot be expanded any further.	

Recipe Database Description Window

The Recipe Database Description Window is a scrollable text area located at the bottom of the Recipe Selection Window (refer to Figure 2-1 on page OP 2–3). User entered information about the selected Folder, Subfolder, or Cassette recipe is displayed in this window.

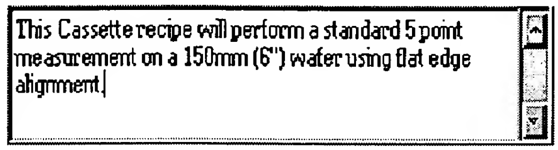


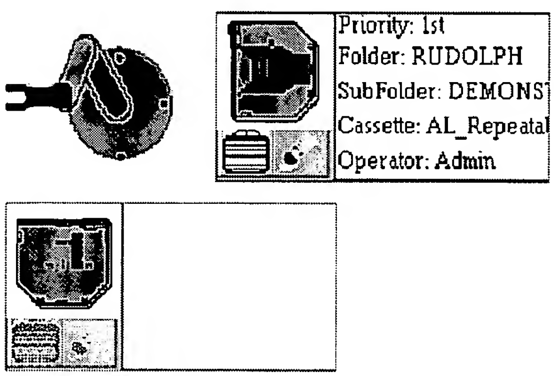
Figure 2-3. Recipe Database Description Window

Load Port Window

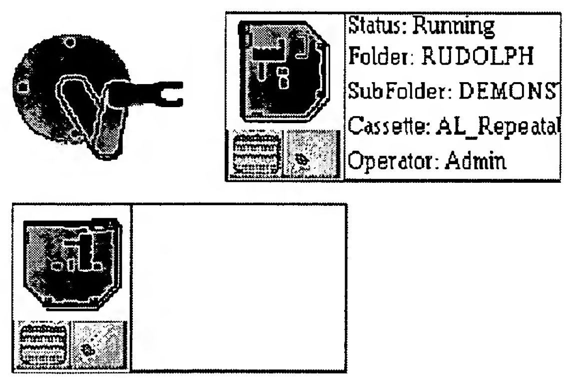
The Load Port Window displays the current status of the wafer handling robot and load ports, and allows you to control the measurement process (start, pause, or abort measurements, or skip the current wafer) and view measurement data for the most recent run.

The Load Port Window consists of the following items:

- **Robot Arm** — A graphic representation of the *Meta*PULSE wafer handling robot arm. When the system is idle, the robot arm points to the left. When a measurement process is running, the robot arm points towards the load port which is in use.



Robot Arm — Idle

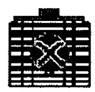


Robot Arm — Recipe Running

Figure 2-4. Robot Arm Status Indications (Examples)

- **Load Ports** — A graphic representation of the load ports on the *Meta*PULSE System. The appearance of the load port icons change to reflect the status of the *Meta*PULSE System as described in Table 2-3:

Table 2-3. Load Port Status Indicators

Icon Appearance	Load Port Status
	A cassette plate icon indicates that no wafer cassette is currently loaded on that load port.
	A wafer cassette icon indicates that a cassette is loaded on the load port, and a Cassette recipe has been selected and is ready to be run.
	A destination wafer cassette icon indicates that wafers will be returned to a cassette placed on this load port after measurements are completed.
	A reject wafer cassette icon indicates that wafers will be returned to a cassette placed on this load port if the measurements are rejected.
	A cassette plate icon with green flashing lights indicates that the selected Cassette recipe is currently being executed on the load port.
	A data icon indicates that measurements have been completed on the wafer(s) loaded on that load port and the measurement data for the run is available.

Under each load port are operator buttons (as shown in Figure 2-5) that allow you to select the desired wafer slots and/or clear (or reset) the load port.

Select Wafer Slot **Clear Load Port**

Figure 2-5. Load Port Operator Buttons

- **Load Port Status Windows** — Displays information on the Cassette recipe that is assigned to the associated load port. This information includes the Folder, Subfolder, and Cassette recipe, the status or priority of the program, and the login name of the Operator running the process.

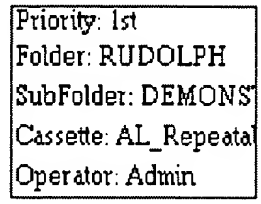


Figure 2-6. Load Port Status Window (Example)

Tool Bar

In Run Mode, the Tool Bar allows you to log in to and out of the System, change views, abort or pause the process being run, skip the wafer currently being measured, and view measurement data of the wafer currently being measured.

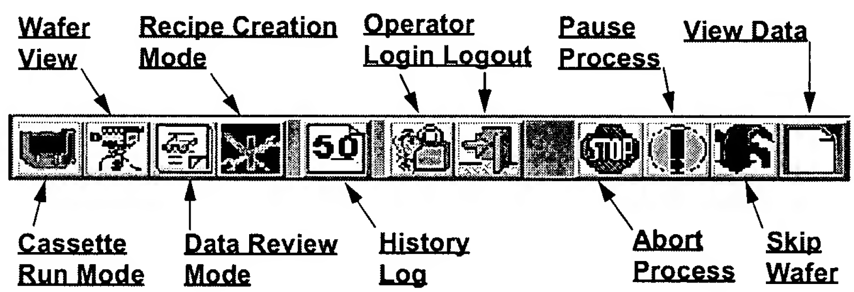


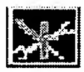
Figure 2-7. Tool Bar — Cassette Run View

NOTE

Not all buttons are active at the same time. Options that are not currently available will have the associated button grayed out (ghosted).

Refer to Table 2-4 for a description of the buttons that are available on the Tool Bar when in Run Mode.

Table 2-4. Tool Bar Button Definitions

Button (Icon)	Name	Function
	Cassette Run Mode	Switch to Cassette Run View.
	Wafer View Mode	Switch to Cassette Wafer View.
	Data Review Mode	Switch to Data Review Mode.
	Recipe Creation Mode	Switch to Recipe Creation Mode.
	History Log	Retrieve and view measurement reports from the history log.
	Operator Login	Allow the Operator to Log in to the system.
	Operator Logout	Allow the Operator to Log out of the system.
	Abort Process	Abort the measurement process currently running.
	Pause Process	Pause the measurement process currently running.
	Skip Wafer	Skip remaining measurements on the currently loaded wafer.
	View Wafer Data	View the measurement data for the process currently running.

Title Bar

The Title Bar, located at the top of the screen, provides an indication of the current mode in which the system is operating.

Figure 2-8. Title Bar (Example)

Status Bar

The Status Bar provides pointer help, information on the current status of the *Meta*PULSE System (such as: Ready, Running Process, Aborting Process, etc), SECS-II communications interface status (Online/Offline, Local/Remote), the Operator login name, and the current system time.

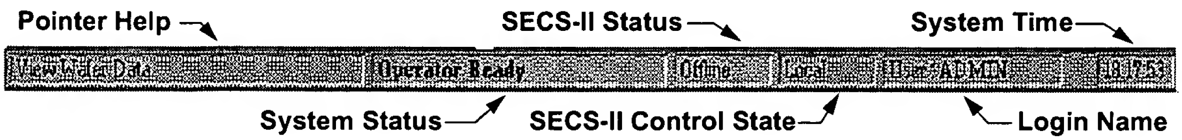


Figure 2-9. Status Bar (Example)

Action Bar

The Action Bar duplicates key buttons on the Tool Bar. This allows quick access to the buttons that control the process currently being run.

Refer to Table 2-4 on page OP 2–9 for descriptions of the buttons available on the Action Bar.

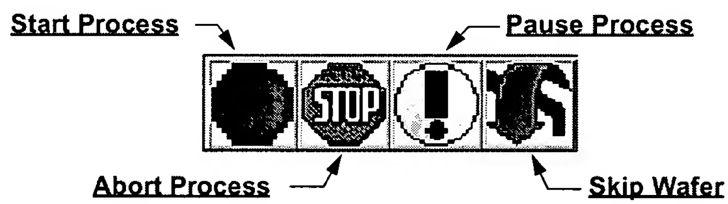


Figure 2-10. Action Bar — Cassette Run View

NOTE

Not all buttons are active at the same time. Options that are not currently available will have the associated button grayed out (ghosted).

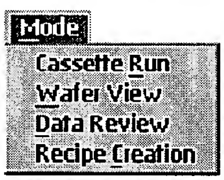
Cassette Run View Main Menu

The Cassette Run View Main Menu provides functions that allow you to change the operating mode of the system, view previous run data, and perform system administrative functions.

Figure 2-11 shows an example of the Cassette Run View Main Menu. A brief description of each menu item is also provided. The menu items that are available will vary depending upon the operating mode of the system. Functions that are not currently available will have the associated menu item grayed out (ghosted).

Figure 2-11. Cassette Run View Menu Bar

The following menu items are available in the Cassette Run View:



- **Mode** — Items in this menu may be used to change the operating mode of the *Meta*PULSE Operator program. The functionality of this menu is duplicated by the mode buttons on the Tool Bar.

  - **Cassette Run** — Causes the system to change to Run Mode and display the Cassette Run View. Tool Bar equivalent button: 

  - **Wafer View** — Causes the system to change to Run Mode and display the Wafer View. Only available if a measurement run is currently in progress. Tool Bar equivalent button: 

  - **Data Review** — Causes the system to change to Data Review Mode. Tool Bar equivalent button: 

    Information for using the *Meta*PULSE Operator program in Data Review Mode is available in the *Meta*PULSE™ Applications Development Guide (Part Number A17944).

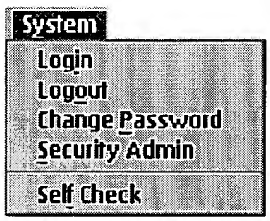
  - **Recipe Creation** — Causes the system to change to Recipe Creation mode. Tool Bar equivalent button: 

    Information for using the *Meta*PULSE Operator program in Recipe Creation Mode is available in the *Meta*PULSE™ Applications Development Guide (Part Number A17944).

SECURITY NOTICE

Depending on your system configuration, you may be required to log in prior to accessing Data Review Mode and/or Recipe Creation Mode.

- **Data** — Allows you to retrieve and view the data for previous process runs. Tool Bar equivalent button: 



- **System** — Allows you to log in and log out of the system. Also provides options for performing certain system configuration and maintenance tasks.

  - **Login** — Logs you in to the system. Tool Bar equivalent button: 

  - **Logout** — Logs you out of the system. Tool Bar equivalent button: 

  - **Change Password** — Allows you to change your password.

SECURITY NOTICE

Depending on system configuration, you may be prevented from changing your password.

  - **Security Admin** — Accesses the security administration screens and functions.

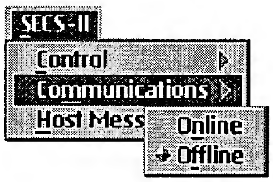
SECURITY NOTICE

You must be a member of the Administrator group in order to access Security Administration.

  - **Self Check** — Performs a self check on the system. The type of self check and the action to be taken by the system (e.g., automatic calibration) are configured by the Administrator.

SECURITY NOTICE

You must be a member of the Administrator or RTIEngineer group in order to perform a self check.

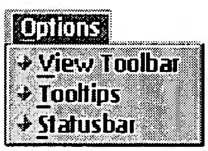


- **SECS-II** — Configures the SECS-II interface.
  - **Control** — Sets control of the *Meta*PULSE System to either **Local** or **Remote**. An icon is displayed beside the active control mode.
  - **Communications** — Sets the SECS-II interface to either **Online** or **Offline**. An icon is displayed beside the item which indicates the current state of communications with a Host computer.
  - **Host Message** — Allows you to send a message to the Host computer.

NOTE

A SECS-II interface must be installed and configured by the Administrator.

Information on the SECS-II interface is available in the VANGUARD SECS-II/GEM Interface Specifications manual (Part Number A17792).



- **Options** — Allows you to set the following user interface options:
  - **View Toolbar** — Toggles the display of the Tool Bar on and off. An icon beside this item indicates the Tool Bar is enabled.
  - **Tooltips** — Toggles the display of the Tooltips on and off. An icon beside this item indicates that Tooltips are enabled.
  - **Statusbar** — Toggles the display of the Status Bar on and off. An icon beside this item indicates the Status Bar is enabled.

- **Exit** — Exits the *Meta*PULSE Operator program and returns you to the OS/2 desktop.

SECURITY NOTICE

Your system may be configured to require you to log in prior to exiting the Operator program.

Wafer View

When a measurement process has been started, the Wafer View is displayed. The Wafer View displays the status of the wafer and the wafer measurement information for the run that is in progress. Once all programmed measurements have been completed, the Wafer View is automatically closed and you are returned to the Cassette Run View.

An example of the Wafer View is shown in Figure 2-12. Descriptions of the various parts of the screen follow the figure.

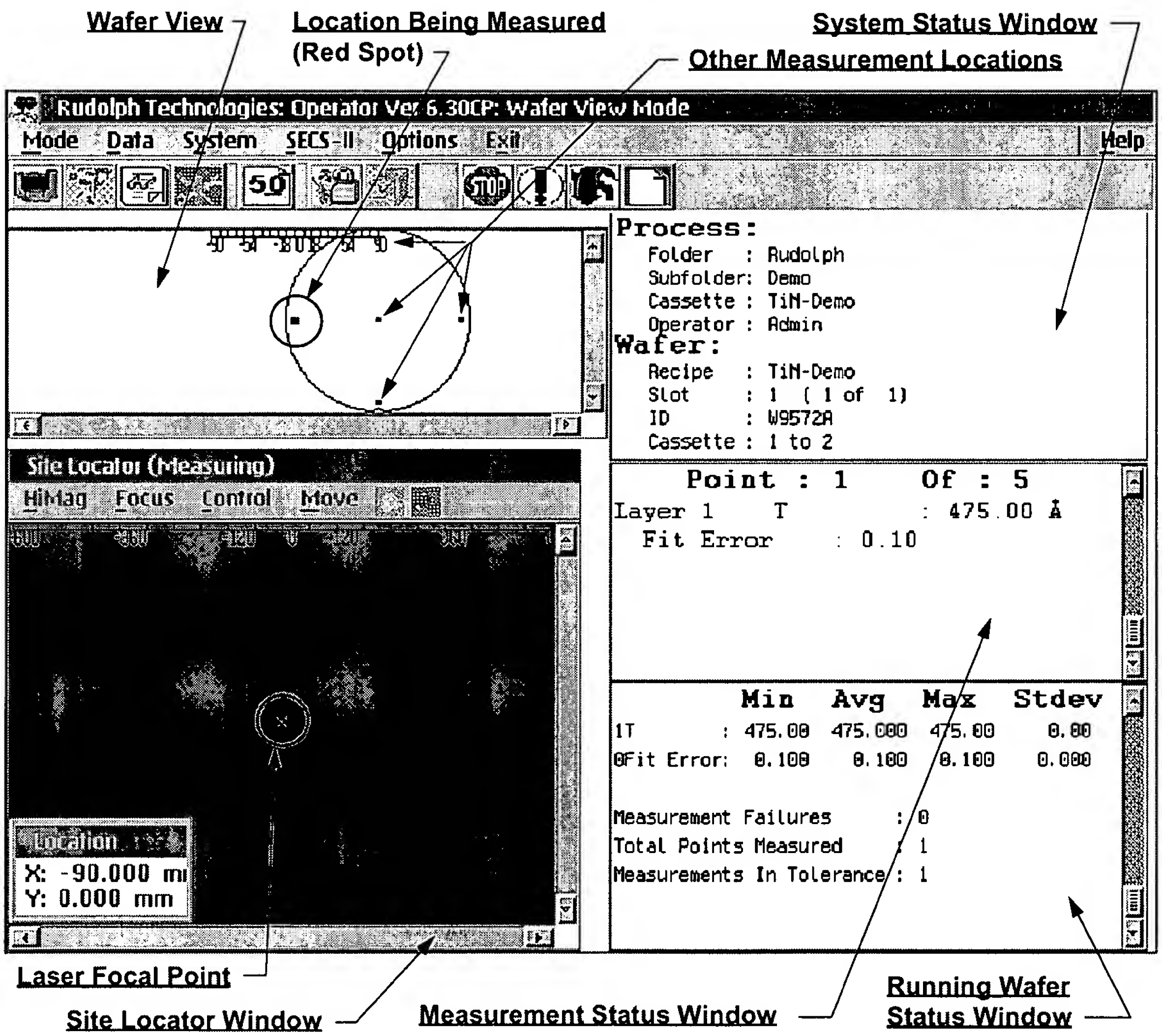


Figure 2-12. Wafer View

Wafer View Main Menu

The Wafer View Main Menu provides the same functionality as the Main Menu in the Cassette Run View.

The Main Menu is shown in Figure 2-11 on page OP 2–11. Refer to "Cassette Run View Main Menu" on page OP 2–11 for a description of each menu item. The menu items that are available will vary depending upon the operating mode of the system. Functions that are not currently available will have the associated menu item grayed out (ghosted).

Tool Bar

The Tool Bar allows you to change views, abort or pause the process being run, skip the wafer currently being measured, and view measurement data of the wafer currently being measured.

The Tool Bar is shown in Figure 2-7 on page OP 2–8. Refer to "Tool Bar" on page OP 2–8 for a description of each button on the Tool Bar. Not all buttons are active at the same time. Options that are not currently available will have the associated button grayed out (ghosted).

Wafer View Window

The Wafer View Window provides a graphical representation of the entire wafer that is currently loaded on the stage and undergoing the measurement process.

Figure 2-13 shows an example of a locator window with a measurement run in progress. The red spot in the square box indicates the location on the wafer currently being measured. Black spots on the wafer indicate locations that will be measured, and blue spots indicate locations that have already been measured.

If no wafer is on the stage, the Wafer View Window will display a square box with a small circle in the center representing the unoccupied stage.

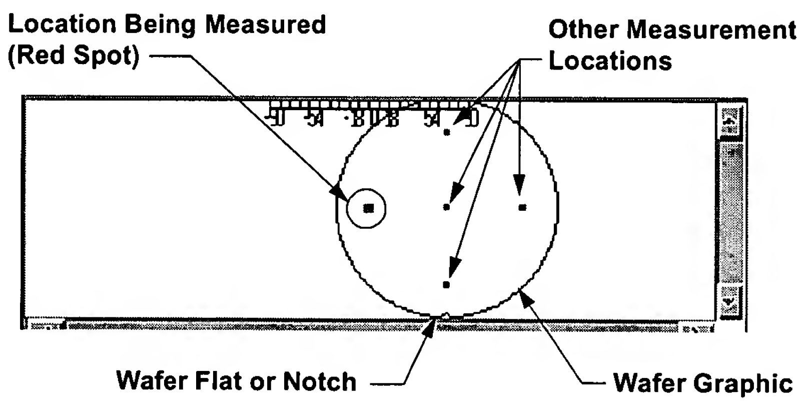


Figure 2-13. Wafer View Window (Example)

Site Locator Window

Located in the lower left corner of the view, the Site Locator Window (also called the Live Video Window) displays a live video image of the position on the wafer currently being measured. The small blue spot in the window indicates the point where the laser is focused on the wafer.

The X and Y coordinates for the laser focal point are shown in the Location box within the Site Locator Window. The coordinates are expressed in millimeters and use the standard Cartesian axes. The origin is set to the wafer center with the flat/notch in the 6 o'clock position.

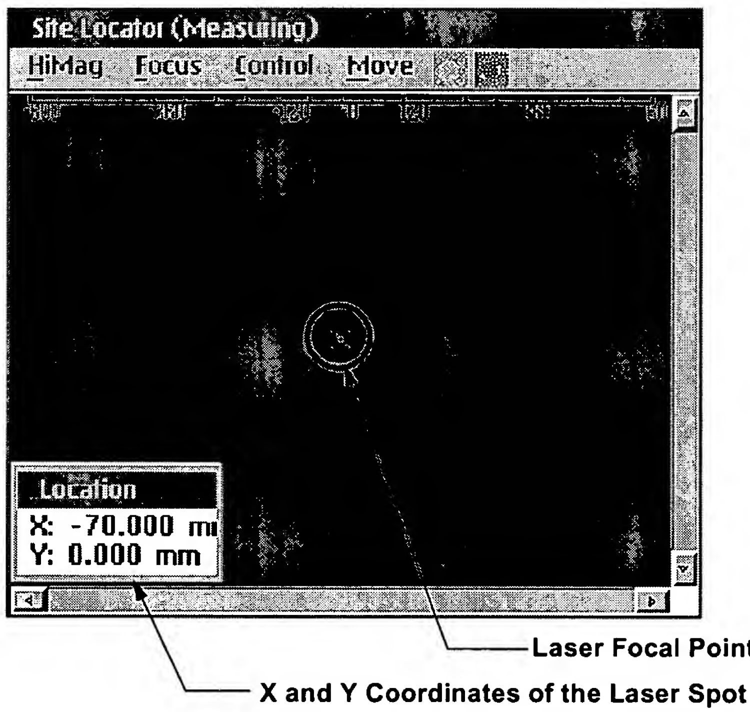


Figure 2-14. Site Locator Window (Example)

NOTE

The menu items in the Site Locator Window are not available in Run Mode.

System Status Window

Located in the upper right corner of the view, this window provides information associated with the current run, including: the Folder, Subfolder, and Cassette name being run, the Operator login name, and the wafer recipe name, slot, wafer ID, and wafer cassette.

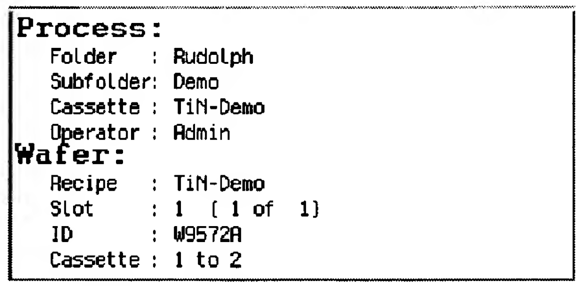


Figure 2-15. System Status Window (Example)

Measurement Status Window

Located in the center right side of the view, this window displays the measurement information and fit error for the previous measurement location. The information in this window is cleared when all measurements on the current wafer have been completed.

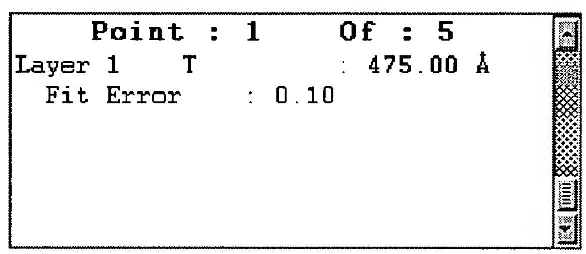


Figure 2-16. Measurement Status Window (Example)

Running Wafer Status Window

Located in the lower right corner of the view, this window displays the statistics for the current wafer. Information includes: measurement information for the location just measured (minimum, average, maximum, standard deviation, and fit error) the number of points measured and the number of measurements in and out of tolerance.

The information in this window is cleared when all measurements on the current wafer have been completed.

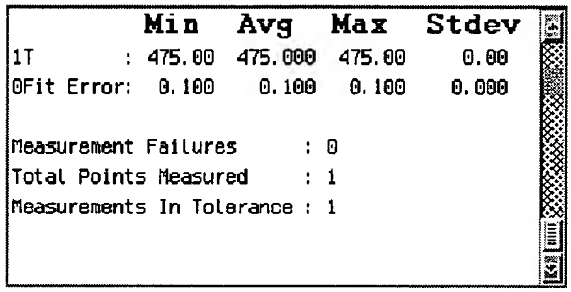


Figure 2-17. Running Wafer Status Window (Example)

Data View

While measurements are being taken, the Data View may be displayed by clicking on the **[View Wafer Data]** icon on the Tool Bar.

The Data View displays the measurement data for each point on each wafer as it is taken. Once all measurements in the run have been completed, the Data View automatically closes and the screen returns to the Cassette Run View.

The Data View is shown in Figure 2-18. While measurements are being taken, only the **Exit** menu item is active. Selecting **Exit** from the Data View menu will close the viewer (the measurement run will continue).

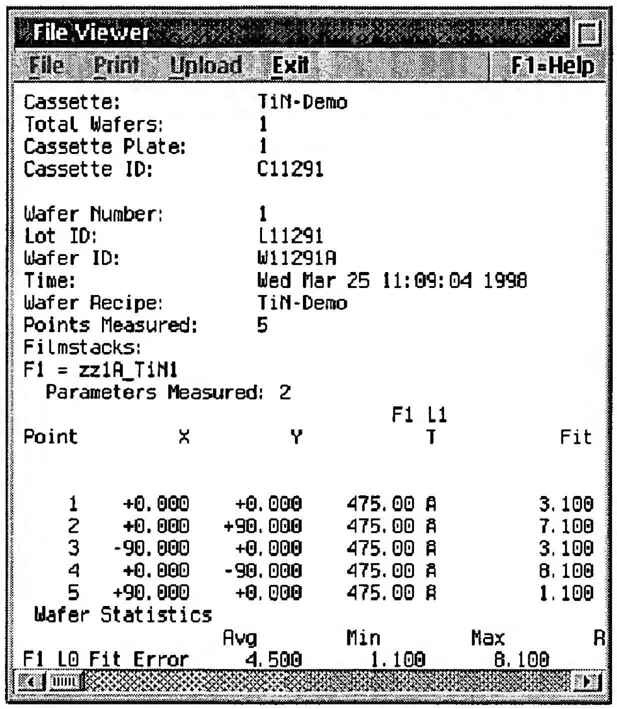


Figure 2-18. Data View

Accessing Run Mode

By default, the *Meta*PULSE Operator program will start up in Run Mode with the Cassette Run View displayed (as shown in Figure 2-19) and you are automatically logged in as **Guest**.

NOTE

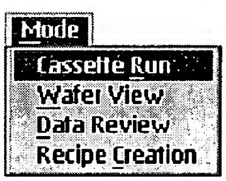
The operating modes the "Guest" user is allowed to access, and the tasks that may be performed in each mode, are determined by the system security configuration and the privilege levels assigned to the Guest account by the Administrator.

1. Perform **one** of the following:

   - **If the Cassette Run View is already displayed:** continue with Step 2.

   - **If the *Meta*PULSE Operator program is not running:** start the *Meta*PULSE System and Operator program as necessary using the procedures provided in Appendix A, "Starting and Stopping the System".

     Once the *Meta*PULSE Operator program has started, the Cassette Run View is displayed as shown in Figure 2-19.



   - **If the *Meta*PULSE Operator program is running but is not currently in Run Mode:** change to Run Mode using one of the following methods

     - Select **Mode** from the Main menu, then **Cassette Run** from the Mode menu.

     - Click on the **[Cassette Run View]** button  on the Tool Bar.

   The Cassette Run View is displayed as shown in Figure 2-19.

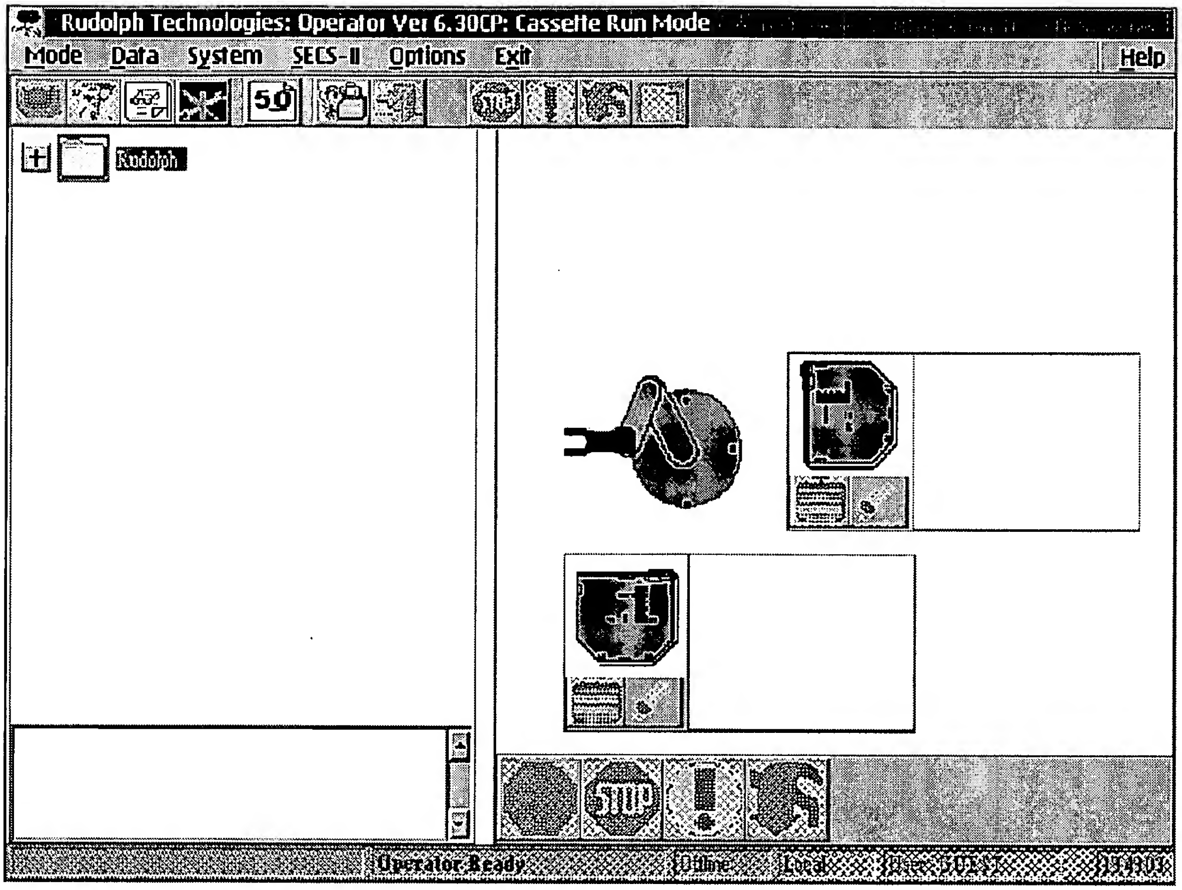


Figure 2-19. Cassette Run View

2. With the Cassette Run View displayed, you may select a Cassette recipe and start a measurement run.

   Refer to "Setting Up a Measurement Run" on page OP 2–22.

Setting Up a Measurement Run

1. Place the cassette(s) that contain the wafer(s) to be measured on the desired load port(s) on the *Meta*PULSE System.

2. In the Recipe Selection Window portion of the Cassette Run View, select a **Folder** by double clicking on the Folder name, or by clicking on the [+] icon beside the Folder name.

   The selected Folder is highlighted and expanded. The Subfolders that are contained within the Folder are displayed.

3. Select a **Subfolder** from the list by double clicking on the Folder name, or by clicking on the [+] icon beside the Folder name.

   The selected Subfolder is highlighted and expanded. The Cassette recipes that are contained within the Subfolder are displayed.

4. Select a **Cassette recipe** from the list by clicking on the Cassette Recipe name.

   The selected Cassette recipe is highlighted.

5. Click on the desired load port (in the Load Port Window portion of the Cassette Run View).

   SECURITY NOTICE

   Depending upon your system configuration, you may be prompted to log in before you are allowed to run the selected Cassette recipe. Once logged in, your login must also be a member of one or more of the groups that have been granted permission to run the recipe by the Owner of the selected recipe.

   - **If measurement parameters (such as transfer specification or map name) were not deferred to the Operator:** the selected load port will change to a wafer cassette icon and the Cassette Status Window is updated as shown in Figure 2-20.

     The Cassette recipe is now ready to be started. Continue with "Starting the Measurements" on page OP 2–26.

   - **If measurement parameters (such as transfer specification or map name) were deferred to the Operator:** continue the procedure with Step 6 to input deferred parameters.

6. A window will be displayed for each of the deferred parameters. Enter the information as required, click on **[Enter]** after each entry.

   Once all of the deferred measurement run parameters have been specified, the selected load port will change to a wafer cassette icon and the Load Port Status Window is updated as shown in Figure 2-20.

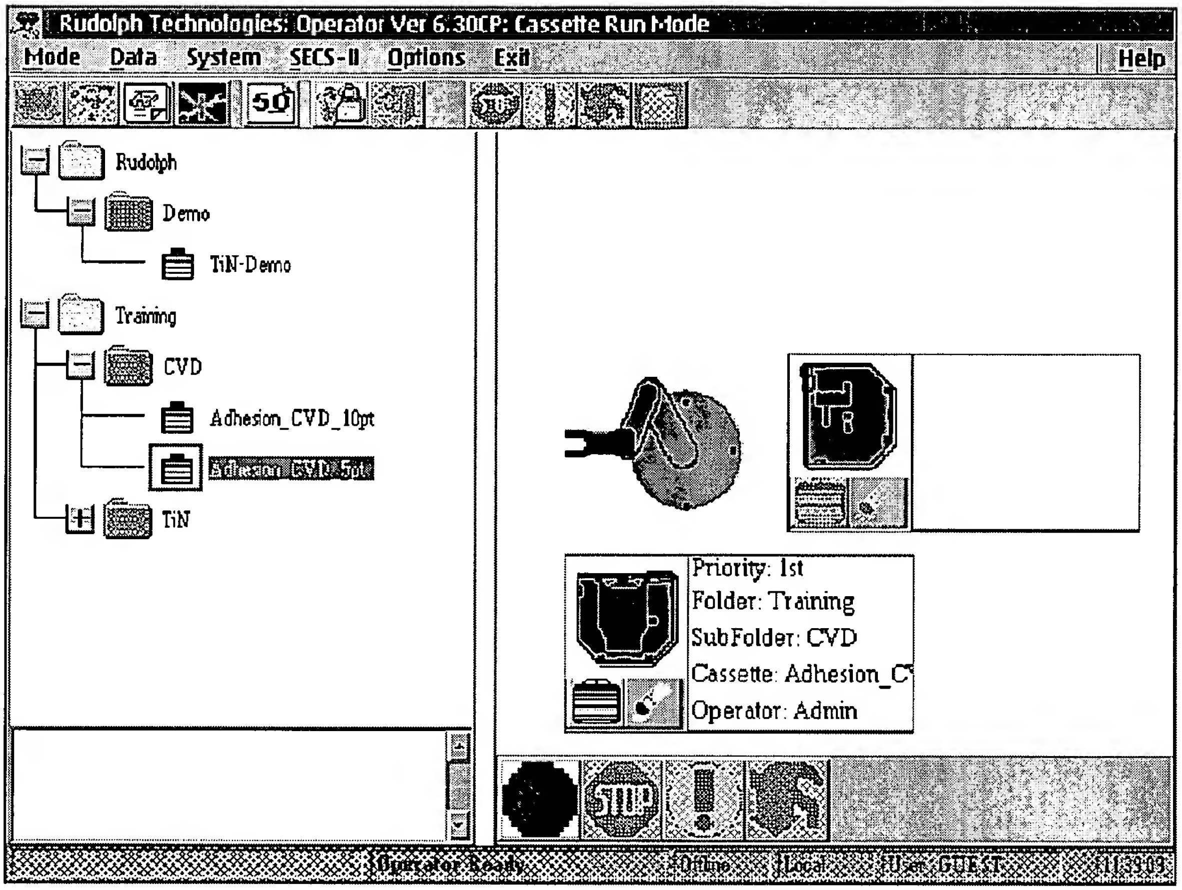


Figure 2-20. Cassette Run View — Measurement Run Ready

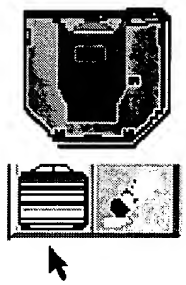
Once the Cassette recipe is assigned to a load port, you may perform any of the following actions:

- Change the selected wafer slots 
- Clear a Cassette recipe from a load port 
- Set up queued loading on the other load port 
- Start the programmed measurements 

After starting the measurements, you may perform any of the following:

- View current measurement data 
- Set up queued loading 
- Pause  or Skip  a wafer measurement
- Abort the measurement run 

Changing Selected Wafer Slots



Select Wafer Slots

Once the Cassette recipe is set up on a load port (load port is shown as a wafer cassette icon), you may change the wafer slot selection for the wafers to be measured.

1. Click on the **[Select Wafer Slots]** button under the load port.

   A Transfer Specification window is displayed (see Figure 2-21). The previously selected slots have a checkmark beside them.

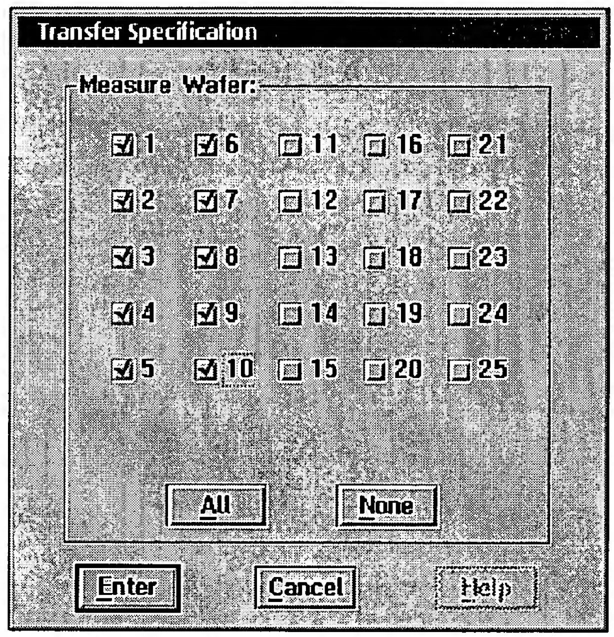


Figure 2-21. Transfer Specification Window

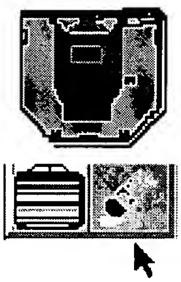
2. Select and/or deselect slots as necessary. Click on **[All]** to select all slots or **[None]** to deselect all slots.

3. Click on **[Enter]** to accept the changes or **[Cancel]** to abort and retain the original settings.

   The Transfer Specification window closes and returns to the Cassette Run View. You may now:

   - Clear the Cassette recipe currently assigned to a load port (see “Clearing a Measurement Run” on page OP 2–25).
   - Start the measurements (see “Starting the Measurements” on page OP 2–26).
   - Queue another cassette of wafers (see “Setting up Queued Loading” on page OP 2–32).

Clearing a Measurement Run



Clear Cassette Plate

Once the Cassette Recipe is set up on a load port (load port is shown as a wafer cassette icon), you may clear the Cassette recipe currently assigned to a load port.

1. Click on the **[Clear Cassette Plate]** button under the load port.

   A message is displayed asking you to confirm that you wish to reset the load port.

2. Perform **one** of the following:

   - **To keep the assigned Cassette recipe:** click on **[No]**.

     The Cassette recipe remains assigned to the load port and you are returned to the Cassette Run View. You may now:

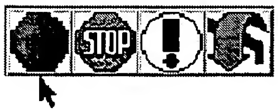
     - Start the measurement (see "Starting the Measurements" on page OP 2–26).
     - Queue another cassette of wafers (see "Setting up Queued Loading" on page OP 2–32).

   - **To clear the Cassette recipe from the load port:** click on **[Yes]**.

     The Cassette recipe is cleared from the load port and you are returned to the Cassette Run View. You may now:

     - Return to "Setting Up a Measurement Run" on page OP 2–22 to select and assign a Cassette recipe to a load port.

Starting the Measurements



Start Process

Once the Cassette recipe is set up on a load port (load port is shown as a wafer cassette icon), you may start the measurements.

With the Cassette Run View displayed (Figure 2-20 on page OP 2–23), perform the following:

1. Click on the **[Start Process]** button in the Action Bar.

   The Wafer View is displayed. The first wafer is loaded and the *Meta*-PULSE System begins to perform the measurements as defined by the selected Cassette recipe.

   Figure 2-22 shows an example of the Wafer View with measurements in progress. For a description of the components that make up the Wafer View, see "Wafer View" on page OP 2–14.

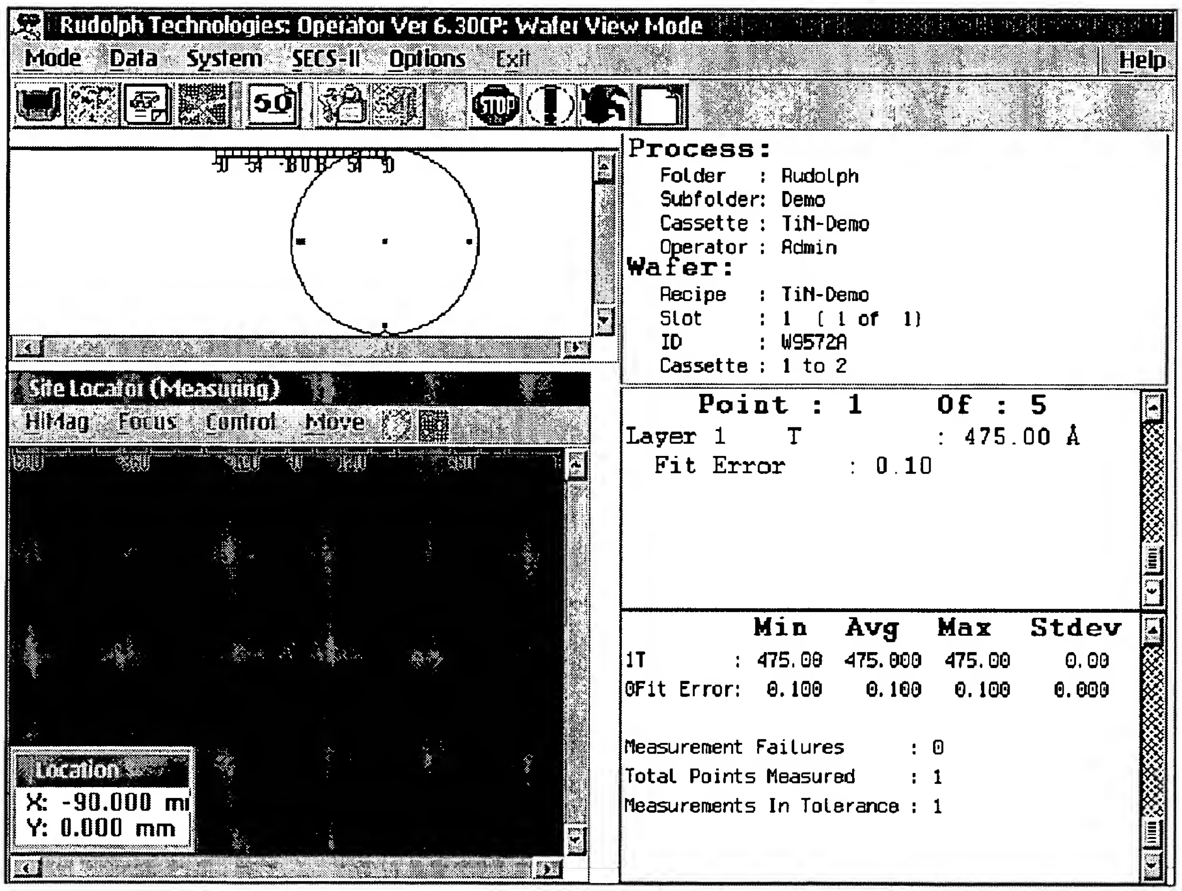


Figure 2-22. Wafer View

2. You may perform any of the following while wafer measurements are in progress:

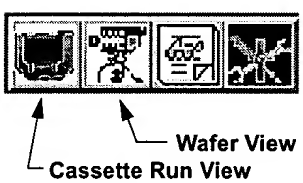
   - Change back to the Cassette Run View 
   - View current measurement data 
   - Pause  or abort  the wafer measurements
   - Skip the current wafer being measured 
   - Queue another cassette of wafers 

Data Icon

When the programmed measurements are complete on all selected wafers, the Cassette Run View is displayed. The load port on which measurements have just completed changes to a **Data** icon (as shown in Figure 2-27 on page OP 2–34). The measurement data for the run just completed can now be retrieved.

Refer to "Measurement Completion" on page OP 2–34 for information on how to retrieve the measurement report. Detailed descriptions of the data that is contained in the report are provided in the *Meta*PULSE™ Applications Development Guide (Part Number A17944).

Switching Between Wafer View and Cassette Run View



While measurements are in progress and the Wafer View is displayed, you may switch between the Wafer and Cassette Run Views as desired.

Using the Tool Bar

1. Click on the **[Cassette Run View]** button in the Tool Bar.

   The Cassette Run View is displayed as shown in Figure 2-23 on page OP 2–28. The active load port is shown with two flashing green lights indicating that the program is running.

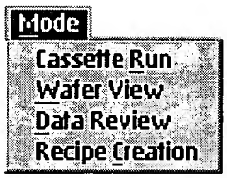
2. Click on the **[Wafer View]** button in the Tool Bar to return to the Wafer View.

   The Wafer View is displayed as shown in Figure 2-22 on page OP 2–26.

NOTE

Wafer View is only available while the measurement run is in progress. If all measurements are completed while the Cassette Run View is displayed, you cannot switch back to the Wafer View.

Using the Main Menu



1. Select **Mode** from the Main menu, then select either **Cassette Run** or **Wafer View** when the Mode menu is displayed.

   The Cassette Run View (Figure 2-23) or Wafer View (Figure 2-22) is displayed as appropriate.

NOTE

Wafer View is only available while the measurement run is in progress. If all measurements are completed while the Cassette Run View is displayed, you cannot switch back to the Wafer View.

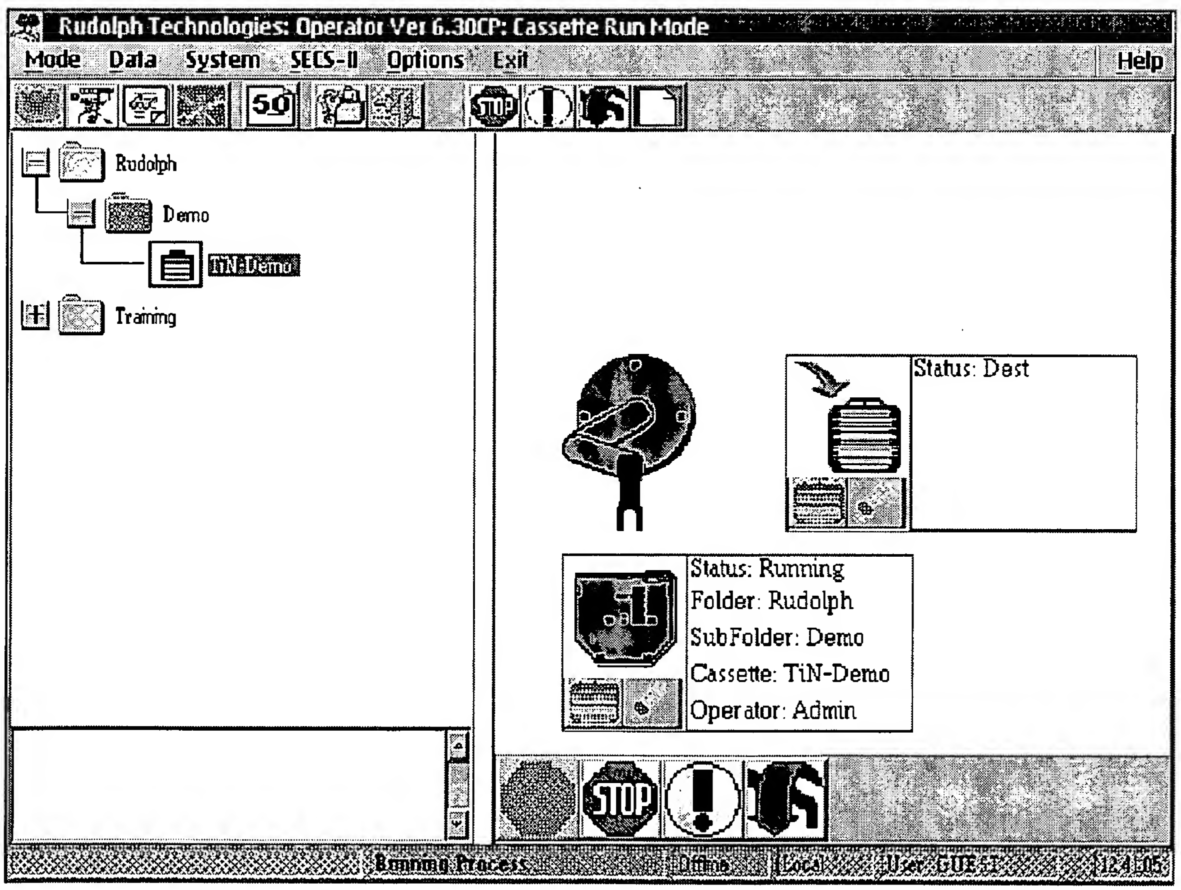


Figure 2-23. Cassette Run View — Measurements in Progress

NOTE

In the example shown in Figure 2-23, wafers from load port 1 are being measured and are returned to load port 2 when measurements are complete.

Viewing Current Measurement Data

View Wafer Data

While measurements are in progress, you may view the data as each measurement is taken.

1. Click on the **[View Wafer Data]** button in the Tool Bar.

   The Data View is displayed as shown in Figure 2-24. This view is updated as each measurement is completed.

NOTE

If you have queued cassettes, the Data View is cleared after the first cassette is completed. Once measurements begin on the second cassette, the second cassette's data is then displayed.

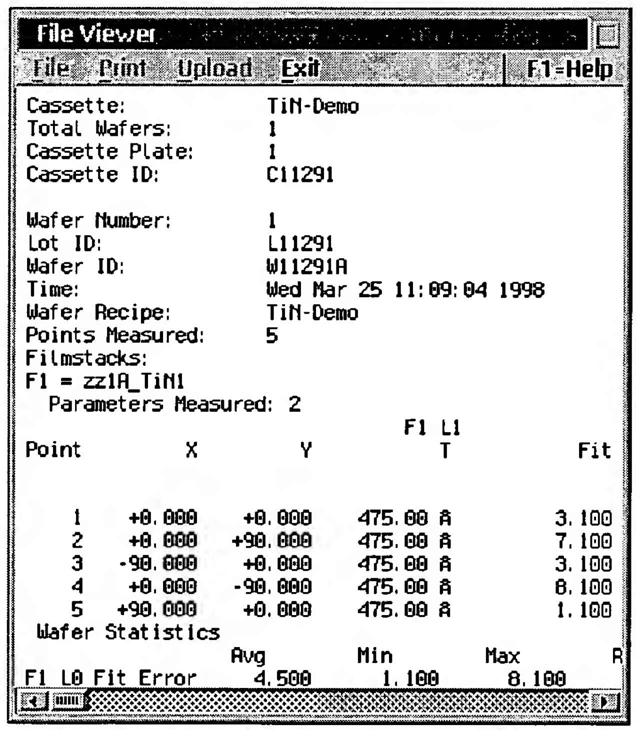


Figure 2-24. Data View

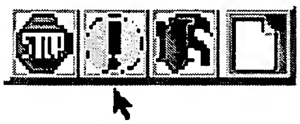
2. Select **Exit** from the Data View Main menu to close the Data View.

   The Data View closes and the Cassette Run View or Wafer View (whichever was active in Step 1) is displayed.

NOTE

The Data View automatically closes when all measurements are completed.

Pausing a Wafer Measurement



Pause Process

While measurements are in progress, you may pause the process.

1. Click on the **[Pause Process]** button in the Tool Bar.

   NOTE

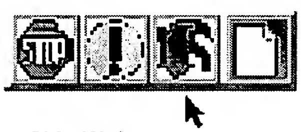
   If the Cassette Run View is displayed, you may click on the [Pause Process] button in either the Tool Bar or Action Bar.

   A message is displayed indicating that processing has been paused.

2. To resume taking measurements, click on **[Resume]**.

   The system resumes making the programmed measurements.

Skipping a Wafer Measurement



Skip Wafer

While measurements are in progress, you may skip the wafer currently being measured.

1. Click on the **[Skip Wafer]** button in the Tool Bar.

   NOTE

   If the Cassette Run View is displayed, you may click on the [Skip Wafer] button in either the Tool Bar or Action Bar.

   A message is displayed asking you to verify that you wish to skip the current wafer.

2. Perform **one** of the following:

   - **To skip the wafer and continue taking measurements on the next wafer in the Cassette recipe**: click on **[OK]**.

     The system stops taking measurements and unloads the current wafer. The next wafer in the program (if any) is loaded and measurements are resumed.

     NOTE

     If there are no additional wafers to be measured, you are returned to the Cassette Run View.

   - **To continue measurements on this wafer**: click on **[Cancel]**.

     The system resumes taking measurements on the current wafer as programmed.

Aborting a Measurement Run

Abort Process

While measurements are in progress, you may abort the currently running Cassette recipe.

1. Click on the **[Abort Process]** button in the Tool Bar.

   NOTE

   If the Cassette Run View is displayed, you may click on the [Abort Process] button in either the Tool Bar or Action Bar.

   A message is displayed asking you to verify that you wish to abort the measurement process.

2. Perform **one** of the following:

   - **To abort the programmed measurements:** click on **[OK]**.

     The system stops taking measurements, unloads the wafer, and you are returned to the Cassette Run View. The load port which had just been running is shown as a **Data** icon.

     - **To view the data from the run that was aborted:** refer to "Viewing Current Measurement Data (Most Recent Run)" on page OP 2–36.

     - **If a cassette was queued on the other load port when the measurements were aborted:** start measurements on the second load port using the procedure provided in "Starting the Measurements" on page OP 2–26.

   - **To continue the programmed measurements:** click on **[Cancel]**.

     The system resumes taking measurements as programmed.

Setting up Queued Loading

In addition to setting up and running a single cassette of wafers, the *Meta*PULSE System has the ability to "queue" multiple cassettes of wafers. Queuing allows for uninterrupted measurements, thus increasing overall system throughput.

Cassettes may be queued either prior to starting the first measurement process, or while measurements are currently being taken.

Queuing Cassettes Prior to Starting Measurements

Use the following procedure to queue multiple cassettes prior to starting the first run:

1. Set up the Cassette recipe for the first cassette of wafers using the instructions provided in "Setting Up a Measurement Run" on page OP 2–22. **DO NOT start the program.**

   In the Cassette Run View, the load port is shown as a wafer cassette icon indicating the program is ready to run. In the Load Port Status Window for that load port, the **Priority** is shown as **1st**.

2. Set up the Cassette recipe for the second cassette of wafers also by following the instructions provided in "Setting Up a Measurement Run" on page OP 2–22.

   In the Cassette Run View, the load port is shown as a wafer cassette icon indicating the program is ready to run. In the Load Port Status Window for that load port, the **Priority** is shown as **2nd**.

   Figure 2-25 shows an example of two cassettes queued and ready to run their programs.

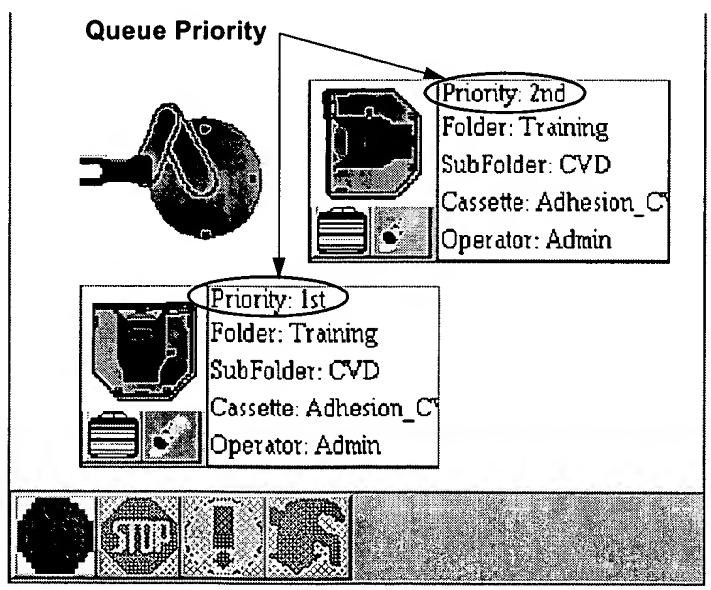


Figure 2-25. Cassette Run View — Cassettes Queued

3. Begin taking measurements using the procedure provided in "Starting the Measurements" on page OP 2–26.

4. Once all measurements are completed on all cassettes, the data is available for review. You may now proceed to "Measurement Completion" on page OP 2–34.

Queuing a Cassette While Measurements are in Progress

Cassette Run View

Use the following procedure to queue another cassette while measurements are in progress on the first cassette:

1. If the Cassette Run View is already displayed, continue with the next step. Otherwise, click on the **[Cassette Run View]** button in the Tool Bar.

   The Cassette Run View is displayed.

2. Set up the Cassette recipe for the second cassette using the instructions in "Setting Up a Measurement Run" on page OP 2–22.

   The Cassette Run View is updated to display the information for the cassette that is currently running, as well as the cassette that has just been queued (as shown in Figure 2-26).

   The measurements for the queued cassette will automatically start when all measurements on the first cassette are completed.

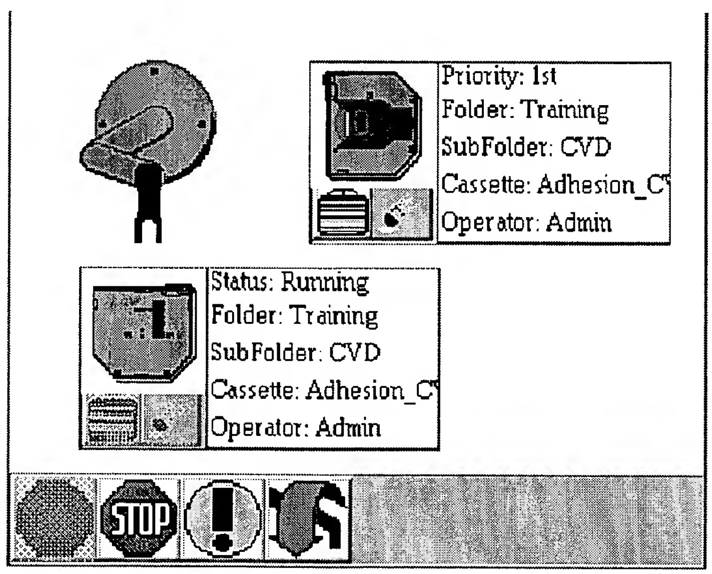


Figure 2-26. Cassette Run View — One Cassette Running, One Cassette Queued

Measurement Completion

When all measurements have been completed, the Cassette Run View is automatically re-displayed. The load port on which measurements have been completed is shown as a **Data** icon.

NOTE

If cassettes are queued, the System automatically begins to process the second cassette when measurements are completed on the first cassette. The Wafer View remains on screen until all measurements are completed or until manually changed.

Data from the first cassette is available and may be viewed while measurements are running on the second cassette.

The **Data** icon indicates that the measurement data for the most recent run is available for viewing. Figure 2-27 shows an example of the Cassette Run View after a measurement process has completed.

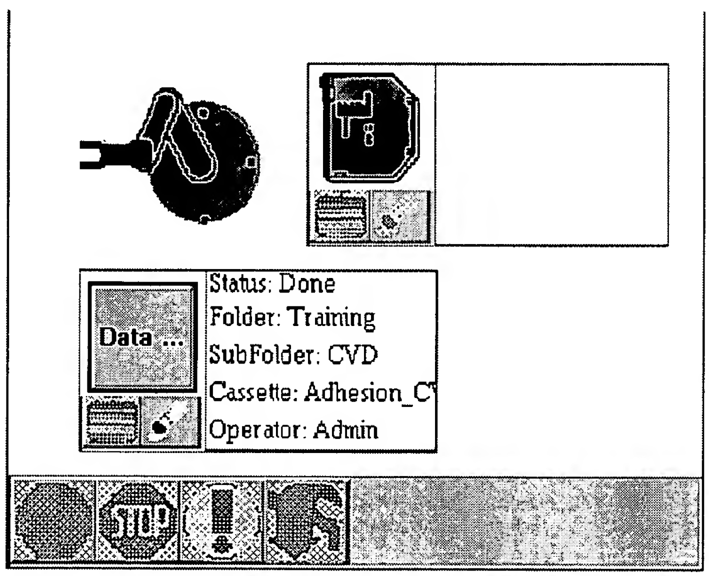


Figure 2-27. Cassette Run View — Measurement Data Ready

The measurement data report provides the following information:

- **Information associated with the process:** such as the Operator that performed the measurements, the Folder, Subfolder, and Cassette recipe used for the measurements, the total number of wafers measured, the load port used, and the cassette ID.
- **Information specific to a particular wafer that was measured:** such as the wafer recipe, wafer slot number, lot ID, wafer ID, and date and time the measurement was performed.
- **Information on the measurement parameters that were used for the wafer:** such as number of points measured, the filmstack, and which parameters were measured.
- **Information on each individual measurement point:** such as the X and Y coordinate of the point, and the measurement data and fit error for each point.

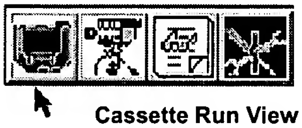
The measurement data report can be viewed immediately following the completion of the measurement run, or the next cassette(s) can be set up to be measured. The measurement data can then be retrieved at a later time by accessing the History Log.

For information on how to retrieve the most recent run's measurement data, refer to "Viewing Current Measurement Data (Most Recent Run)" on page OP 2–36.

For information on retrieving measurement data from the History Log, refer to "Viewing Measurement Data from Previous Runs (History Log)" on page OP 2–38.

For more detailed information on the contents of the measurement report, refer to the *Meta*PULSE™ Applications Development Guide (Part Number A17944).

Viewing Current Measurement Data (Most Recent Run)



Cassette Run View

Data Icon

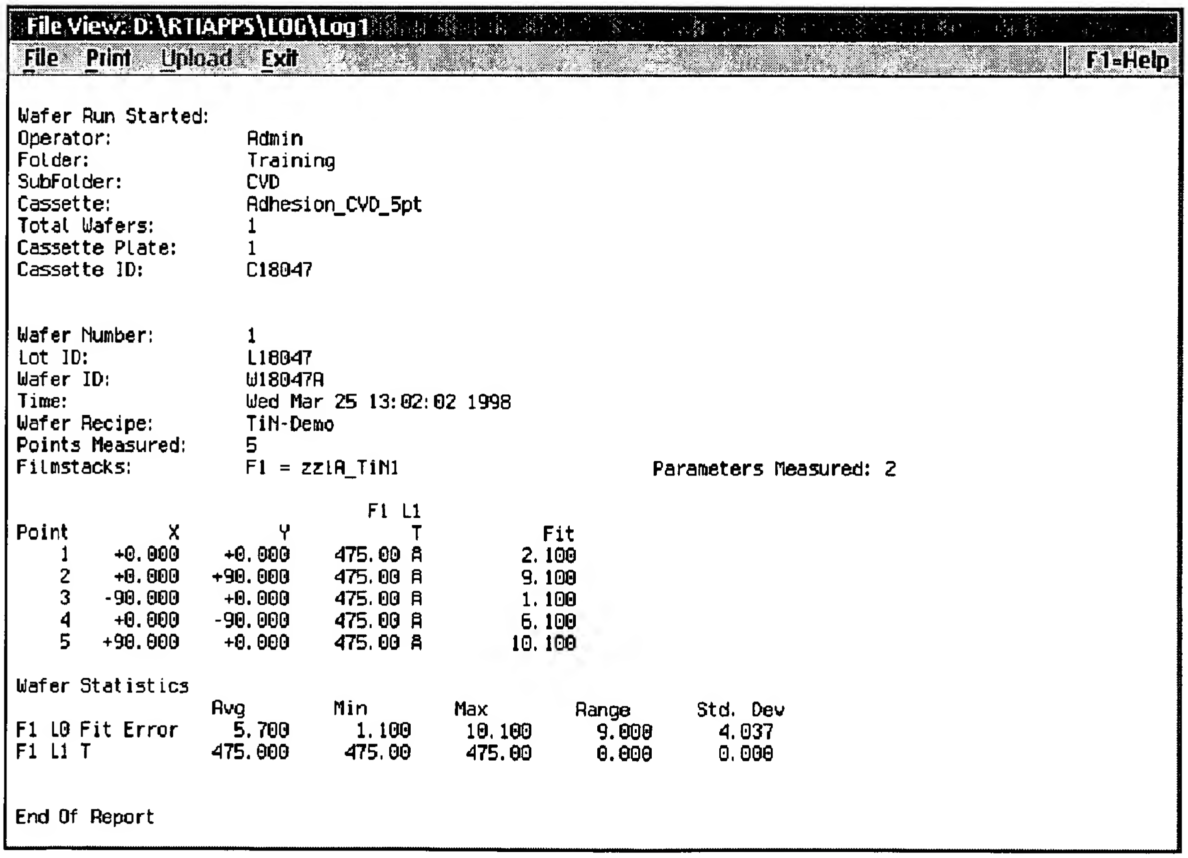
Use the following procedure to view the measurement data report for the measurement run that was just completed:

1. If the Cassette Run View is already displayed, continue with the next step. Otherwise, click on the **[Cassette Run View]** button in the Tool Bar.

   The Cassette Run View is displayed as shown in Figure 2-27 on page OP 2–34.

2. Click on the **Data** icon on the desired load port.

   A File View window is displayed (as shown in Figure 2-28) with the measurement data for the run that just completed on the selected load port.



Wafer Run Started:
Operator: Admin
Folder: Training
SubFolder: CVD
Cassette: Adhesion_CVD_5pt
Total Wafers: 1
Cassette Plate: 1
Cassette ID: C18047

Wafer Number: 1
Lot ID: L18047
Wafer ID: W18047A
Time: Wed Mar 25 13:02:02 1998
Wafer Recipe: TiN-Demo
Points Measured: 5
Filmstacks: F1 = zzlA_TiN1 Parameters Measured: 2

Point	X	Y	F1 L1 T	Fit
1	+0.000	+0.000	475.00 A	2.100
2	+0.000	+90.000	475.00 A	9.100
3	-90.000	+0.000	475.00 A	1.100
4	+0.000	-90.000	475.00 A	6.100
5	+90.000	+0.000	475.00 A	10.100

Wafer Statistics

	Avg	Min	Max	Range	Std. Dev
F1 L0 Fit Error	5.700	1.100	10.100	9.000	4.037
F1 L1 T	475.000	475.00	475.00	0.000	0.000

End Of Report

Figure 2-28. Sample Report File

3. After viewing the report on-line, you may:

   - **Save the data in the report to a text file:** select **File** from the File Viewer Main menu, then **Save As** from the File menu. Enter the desired destination path and filename in the dialog box that is displayed and click on **[Enter]**.

     NOTE

     The default path is d:\rtiapps\bin.

     The data is saved in the specified file and may be imported into a word processor or spreadsheet.

   - **Print the report:** select **Print** from the File Viewer Main menu. Ensure that a printer is properly connected to the *Meta*PULSE System, is turned on, and is on-line.

     NOTE

     Refer to the documentation provided with the printer for instructions on how to use the printer.

   - **Upload the data to a host:** select **Upload** from the File View Main menu.

     NOTE

     The SECS-II interface must be on-line to upload the data to the host, and this option must be enabled in the wafer report. If the SECS-II interface is not on-line, this menu item is not available (ghosted).

   - **Quit the report viewer:** select **Exit** from the File Viewer Main menu.

     The report viewer closes and you are returned to the Cassette Run View. The load port is now reset and may be programmed for another measurement run.

     NOTE

     The data contained in the report remains in the history log file after closing the report viewer.

Viewing Measurement Data from Previous Runs (History Log)

The *Meta*PULSE System maintains a history log of previously run measurement data. The number of measurement reports that will be saved in the history log is determined by your system setup. The default is typically 10.

NOTE

If the history log file already contains the maximum number of measurement data reports, the next time measurements are performed the new report is saved in the history log file and the oldest report in the history log file is removed.

When in Run Mode, the measurement history log can be accessed using the Main menu or the **[Review Log Files]** button on the Tool Bar.

NOTE

The history log may be accessed while measurements are in progress.

1. Perform **one** of the following:

   - **To access the history log from the Main menu:** in Run Mode (with either the Cassette Run View or Wafer View displayed), select **Data** from the Main menu.

   - **To access the history log from the Tool Bar:** in Run Mode (Cassette Run View only), click on the **[Review Log Files]** button in the Tool Bar.

   The Process Run Data Retrieval Window is displayed as shown in Figure 2-29.

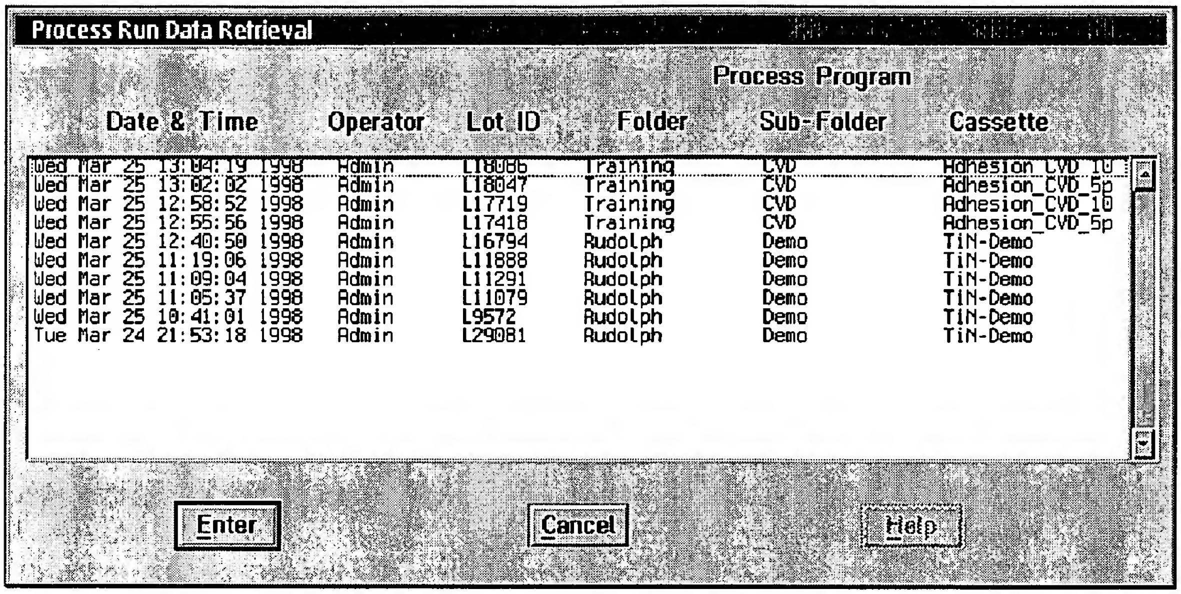


Figure 2-29. Process Run Data Retrieval Window

The Process Run Data Retrieval Window displays the following information for each of the measurement data reports currently saved in the history log:

- The date and time the measurements were performed.
- The login name of the Operator who performed the measurements.
- The Lot ID for the wafer cassette.
- The Folder, Subfolder, and Cassette recipe used to perform the measurements.

2. Select a report by double clicking on the desired entry, or click on the report and then click on **[Enter]**.

   The selected measurement data report is displayed similar to the example shown in Figure 2-28 on page OP 2–36.

3. After viewing the report on-line, you may:

   - **Save the data in the report to a text file:** select **File** from the File Viewer Main menu, then **Save As** from the File menu. Enter the desired destination path and filename in the dialog box that is displayed and click on **[Enter]**.

     NOTE

     The default path is d:\rtiapps\bin.

     The data is saved in the specified file and may be imported into a word processor or spreadsheet.

   - **Print the report:** select **Print** from the File Viewer Main menu. Ensure that a printer is properly connected to the *Meta*PULSE System, is turned on, and is on-line.

     NOTE

     Refer to the documentation provided with the printer for instructions on how to use the printer.

   - **Upload the data to a host:** select **Upload** from the File View Main menu.

     NOTE

     The SECS-II interface must be on-line to upload the data to the host, and this option must be enabled in the wafer report. If the SECS-II interface is not on-line, this menu item is not available (ghosted).

   - **Quit the report viewer:** select **Exit** from the File Viewer Main menu.

     The report viewer closes and you are returned to the Cassette Run View. The load port is now reset and may be programmed for another measurement run.

     NOTE

     The data contained in the report remains in the history log file after closing the report viewer.

Starting and Stopping the System

Appendix A

Introduction

This appendix provides detailed procedures for starting and stopping your *Meta*PULSE System.

The topics covered in this appendix include:

SECURITY NOTICE

Exiting the Operator program is subject to system security. If you do not have the appropriate access levels, you will be prevented from exiting the Operator program.

NOTE

The procedures in this guide assume that once the *Meta*PULSE System is started after installation it will be left on. The shutdown procedures are provided for possible service requirements or emergency situations.

*Meta*PULSE System Power Control Panel

All *Meta*PULSE Systems have one or more power control panels that allow you to power the system on and off under both normal and emergency conditions.

Depending on the type of system (either *Meta*PULSE 200 or *Meta*-PULSE 300), the power control panel(s) will have one or both of the following switches:

- **Emergency Off (EMO) switch** — Large red switch for emergency use. Pressing this switch shuts down the system including all airflow and the computer. The EMO switch must be reset before power may be re-applied.
- **Power On/Off switch** — Green switch (located to the right of the EMO switch) used to turn the system on and off under normal operating conditions.

CAUTION

Any information not yet stored to disk is lost when either switch is pressed.

*Meta*PULSE 200 System

*Meta*PULSE 200 Systems have one power control panel that is located on the Measurement Module to the right of the video display. Both a Power On/Off and an Emergency Off (EMO) switch are available.

The power control panel is shown in Figure A-1 on page OP A-3. Refer to Figure 1-1 on page OP 1-2 for the location of the power control panel.

*Meta*PULSE 300 System

*Meta*PULSE 300 Systems have two power control panels: one on the cleanroom side of the unit (front) and one on the chase side (rear).

The power control panel on the chase side is located on the Main User Interface (as shown in Figure 1-2 on page OP 1-3). Both a Power On/Off switch and an Emergency Off (EMO) switch are available on this power control panel.

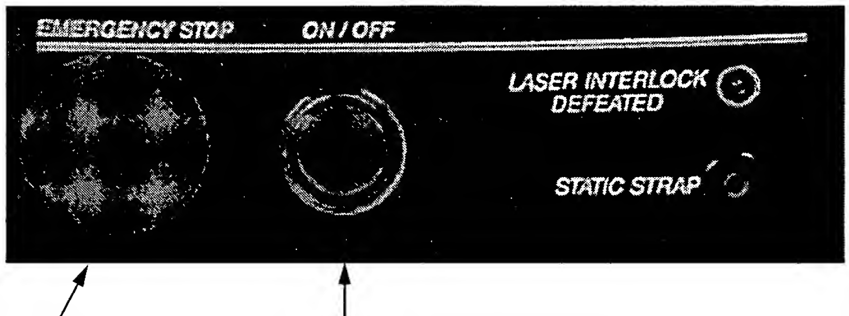
The power control panel on the cleanroom side is located above and between the two load ports (as shown in Figure 1-3 on page OP 1-4). Only an Emergency Off (EMO) switch is available on this power control panel.

NOTE

A Power On/Off switch is also provided on the Optional User Interface Module.

Figure A-1 shows the power control panel that is on *Meta*PULSE 200 Systems and on the chase side (rear) of *Meta*PULSE 300 Systems.

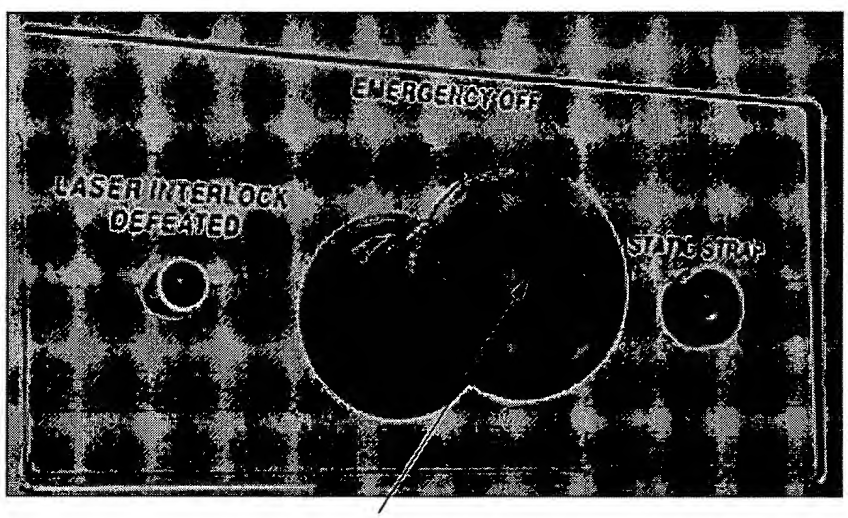
Figure A-2 shows the power control panel that is on the cleanroom side (front) of *Meta*PULSE 300 Systems.



Power On/Off Switch

Emergency Power Off (EPO) Switch

Figure A-1. Power Control Panel — *Meta*PULSE 200 and *Meta*PULSE 300 (Chase)



Emergency Power Off (EPO) Switch

Figure A-2. Power Control Panel — *Meta*PULSE 300 (Cleanroom)

*Meta*PULSE Laser Control Panel

Each *Meta*PULSE System is equipped with a Laser Control Panel. On a *Meta*PULSE 200 System, the Laser Control Panel is located inside the Robot Module. On a *Meta*PULSE 300 System, the Laser Control Panel is located on the bottom shelf.

The Laser Control Panel is shown in Figure A-3. The Laser Starter Key and the Laser Control Menu keys are highlighted.

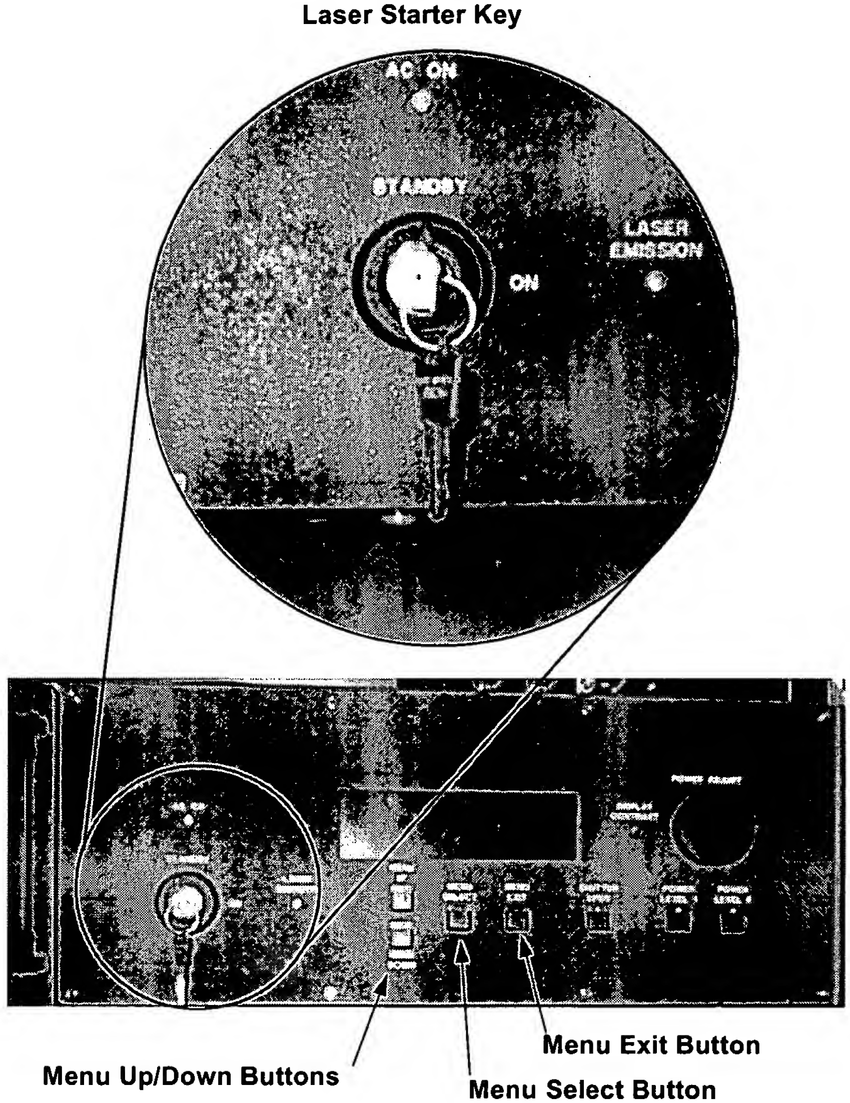


Figure A-3. Laser Control Panel

Normal System Startup

To startup your *Meta*PULSE System, use the following procedure:

1. Ensure that all facilities (water, air, and vacuum) are connected to the system, and that power is available (the power cord is plugged into the wall outlet and the main power breaker for that outlet is turned on).

2. Perform the following steps on the Chiller Module (refer to Figure 1-4 on page OP 1-5 for switch locations):

   - Turn on the Chiller Module.
   - Set the temperature to **25°C**.
   - Set the Refrigeration and Flow Rate to **MAX**.

3. Warm up the laser by performing the following steps from the Laser Control Panel (refer to Figure A-3 on page OP A-4):

   - Turn the Laser Starter Key to the **STANDBY** position.
   - Press the **Menu Select** button then press the **Menu Up/Down** arrow buttons until **LBO Temperature Settings** is displayed.
   - Press the **Menu Select** button to begin heating the laser LBO crystal.
   - Press the **Menu Exit** button until the main screen with the laser status summary is displayed. While the laser is warming up, continue with the next step.

NOTE

After approximately 45 minutes the message "All Servos Locked" appears, signifying that the laser has warmed up. After this message is displayed, the Laser Starter Key may be turned to the "On" position.

CAUTION

Do not turn the Laser Starter Key to the "ON" position before the "All Servos Locked" message is displayed.

4. Press the green Power On/Off switch on the *Meta*PULSE System power control panel (Figure A-1 on page OP A-3) while the laser is warming up.

5. Press the computer **Reset** button to reboot the computer. Figure A-4 shows the location of the Reset button.

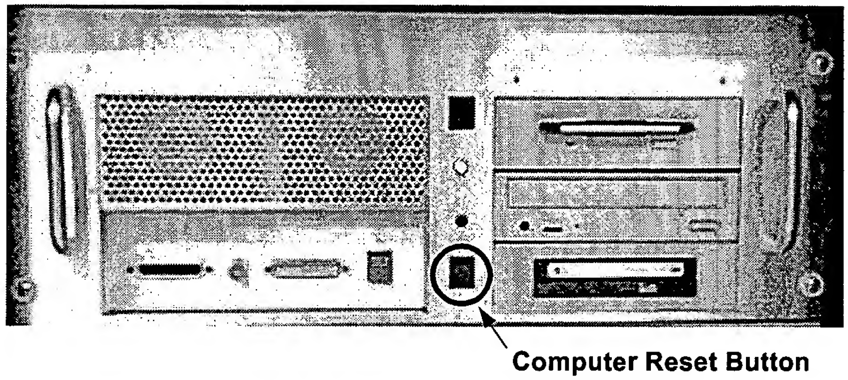


Figure A-4. Computer Reset Button Location

The computer operating system boots up and the OS/2 desktop is displayed.

6. On the Laser Control Panel, verify that the message **All Servos Locked is displayed**. Turn the Laser Starter Key to the **ON** position.

7. If the system power has been off for an extended period of time (longer than one hour), the system should be allowed to warm up for at least one hour before attempting to take measurements.

NOTE

The *Meta*PULSE Operator program may be started during the warm up period if desired. This will allow the system self-check software to calibrate the system during the warm-up period. Refer to "Starting the MetaPULSE Operator Program" on page OP A–9.

8. If not started during the warm up period in Step 7, start the *Meta*PULSE Operator program using the instructions provided in "Starting the MetaPULSE Operator Program" on page OP A–9.

The stage, robot, vision software, and SECS-II connections (if available) initialize when the Operator program is started.

9. When the *Meta*PULSE Operator program is running, select **System** from the Main menu then select **Self Check** when the System menu is displayed.

The system performs a self-check. Once completed, the system is ready for use.

Normal System Shutdown

To perform a normal System shutdown, use the following procedure:

CAUTION

The *Meta*PULSE System should be allowed to run for a minimum of 24 hours. Excessive startup and shutdown of the system may decrease the life of the laser diode.

1. Remove all wafers from the stage and the robot either automatically or manually by using a vacuum wand.
2. Exit the *Meta*PULSE Operator program using the procedures in "Exiting the MetaPULSE Operator Program" on page OP A–14.

   You are returned to the OS/2 desktop.
3. Remove any disks from the floppy drive and/or Jaz drive.
4. RIGHT click on the OS/2 desktop background (not in a window).

   A menu of OS/2 system commands is displayed.
5. Select **Shut down** from the menu.

   The computer shuts down. A message is displayed when the shutdown is complete stating that it is safe to turn off the system.
6. Press the green Power On/Off switch on the *Meta*PULSE System power control panel to turn off the system. The laser will continue to draw power, however all lasing will stop.
7. Performing the following steps from the Laser Control Panel (refer to Figure A-3 on page OP A-4):
   - Turn the Laser Starter Key to the **STANDBY** position.
   - Press the **Menu Select** button then press the **Menu Up/Down** arrow buttons until **LBO Temperature Settings** is displayed.
   - Press the **Menu Select** button to begin LBO cooling.
   - Press the **Menu Exit** button until the main screen with the laser status summary is displayed.
8. Wait 45 minutes to allow the laser to cool down then turn off the Chiller Module (refer to Figure 1-4 on page OP 1-5).
9. When the System is powered off, the power cord can be removed from the outlet or the main power breaker may be shut off. You may also disconnect the vacuum, air, and water lines if desired.

Emergency System Shutdown

To perform an emergency System shutdown, press the red Emergency Off (EMO) switch on the *Meta*PULSE System power control panel (refer to Figure A-1 and Figure A-2 on page OP A-3).

When the switch is pressed the following will occur:

1. The stage and robot will stop moving.
2. The laser shutters will close and the laser will turn off.
3. The *Meta*PULSE System shuts down (including the computer). The laser also is shut down and all air flow around and through the unit is stopped.

CAUTION

Any information not already saved to disk is lost.

Recover from an Emergency System Shutdown

After the Emergency Off (EMO) switch has been pressed and the *Meta*-PULSE System is shutdown, perform the following to restart the System:

1. Use a vacuum wand to clear any wafers from the robot or stage.
2. Press the green Power On/Off switch on the power control panel (refer to Figure A-1 on page OP A-3) one time to set it to the "off" position.

NOTE

The next step must be performed with the power off to ensure a proper recovery.

3. Reset the EMO switch by rotating the switch in a clockwise direction until it pops back out.
4. Start up the system. Refer to "Normal System Startup" on page OP A–5 for information.

Starting the *Meta*PULSE Operator Program

To start the *Meta*PULSE Operator program, double click the **Operator** icon located in the **RTI Applications** folder on the OS/2 desktop.

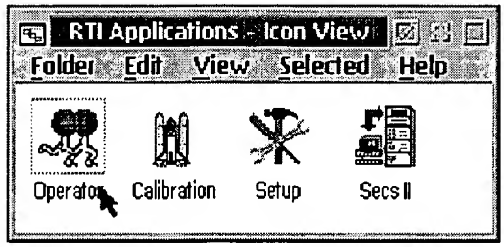


Figure A-5. RTI Applications Folder (OS/2 Desktop)

After an introductory screen, the Cassette Run View is displayed, as shown in Figure A-6.

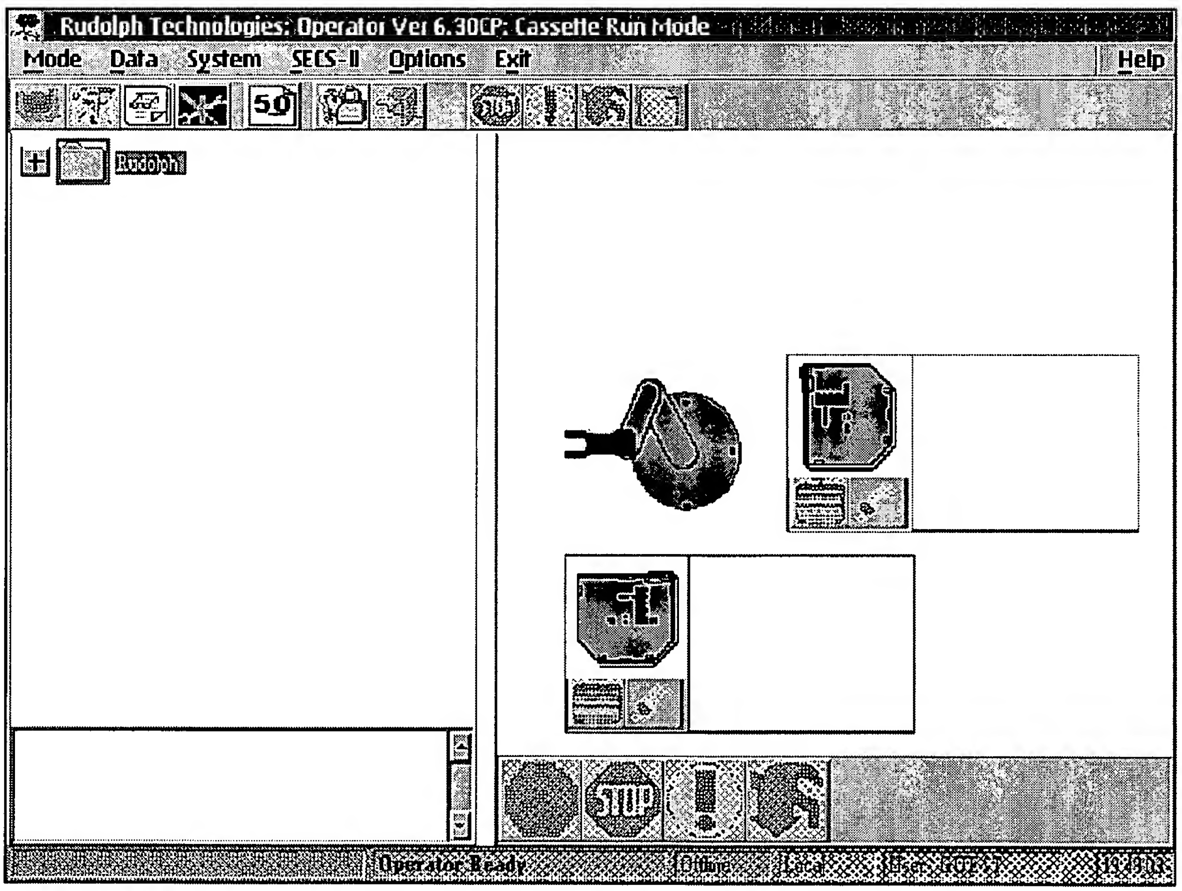


Figure A-6. Cassette Run View

When the *Meta*PULSE Operator program is first started, you are automatically logged in as user **Guest**.

While logged in as **Guest**, the actions that you are permitted to perform are determined by the system security configuration and the access privileges set by the Administrator for the Guest account.

- **If system security is not enabled:** no protection is enforced and you are permitted to perform any action.
- **If system security is enabled, but logins are disabled:** the Guest user has very limited privileges. You are permitted to browse the recipe database, run Cassette recipes and switch to and from various operating modes (depending upon system configuration).
- **If system security and logins are enabled:** access to certain operating modes and functions, and to the recipe database editing functions (creating, modifying, deleting, etc.) are determined by the security profile for each user (including the Guest user) as configured by the system administrator.

  If logged in as **Guest** (or as a user that does not have permission to perform the selected action), the User Login window will be displayed (as shown in Figure A-7 on page OP A-12) when a protected area or object is accessed. Refer to "Logging In and Logging Out" on page OP A–11 for information on how to log in to the system.

Once you have started the *Meta*PULSE Operator program and logged in (if required), refer to Chapter 2, "Running Recipes" for information on how to browse the recipe database and select a Cassette recipe to run.

Information on editing the recipe database, creating or modifying recipes (and the components that make up a recipe), and retrieving and/or manipulating measurement data (including the creation of wafer maps and graphs), is available in the "*Meta*PULSE™ Applications Development Guide" (Part Number A17944).

Logging In and Logging Out

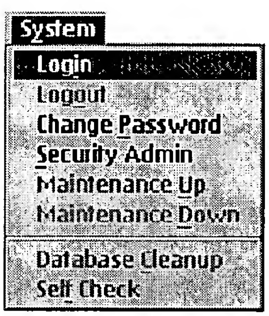
Your system may be configured to require a log in before you are permitted to perform certain tasks. This configuration can be set in either of two ways:

- A log in is required each time you attempt to access a protected resource or perform a privileged task. Once you have completed the selected function, the system automatically logs you out and you are returned to the **Guest** login.
- A log in is required only the first time you attempt to access a protected resource or perform a privileged task. When you have completed the selected function, the system does not log you out automatically. If you then attempt to perform a function for which your current login does not have permission, the system will prompt you to log in with a different name.

If system security is enabled, you may opt to manually log in prior to having the system prompt you to do so. However, the same conditions apply as listed above regarding the automatic logout after completing the selected function.

Logging In to the System

Once you have started the *Meta*PULSE Operator program (see "Starting the MetaPULSE Operator Program" on page OP A-9), you may manually log in by using either the Main menu or Tool Bar, or the system may automatically prompt you to log in when you attempt to access a protected function.



Use the following procedure to log in to the *Meta*PULSE System:

1. Perform **one** of the following:

   - **To manually initiate a log in:** either select **System** from the Main menu then select **Login** from the System menu, or click on the **[Operator Login]** button in the Tool Bar. 

     The User Login window is displayed as shown in Figure A-7.

   - **If the System prompts you to log in:** the User Login window is displayed as shown in Figure A-7. Continue with the next step.

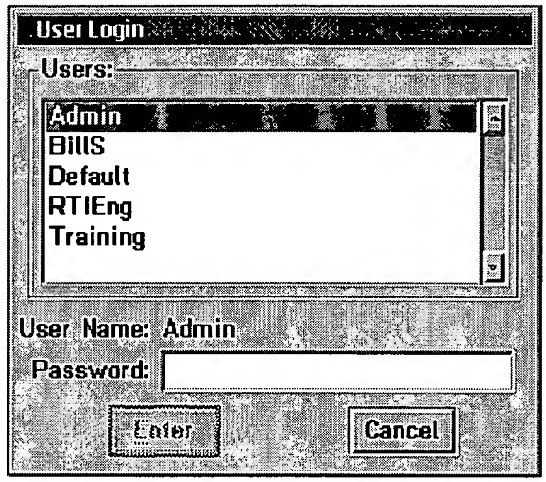


Figure A-7. User Login Window

2. Select your login name from the list.

   The name is highlighted and displayed in the **User Name** field.

SECURITY NOTICE

Passwords may or may not be required depending upon your system configuration.

3. Perform **one** of the following:

   - **If passwords are not required (Password field not displayed):** click on **[Enter]**.
   - **If passwords are required:** Click in the **Password** field of the User Login window, enter your password, then click on **[Enter]**.

SECURITY NOTICE

For security reasons, asterisks (*) will be displayed as you enter your password.

Passwords may or may not be case sensitive depending upon your system configuration.

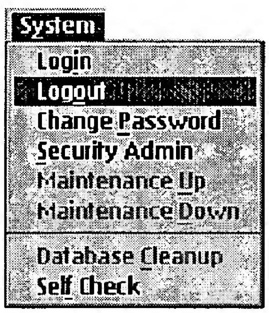
Once a username/password pair has been entered that has the privilege level for the selected function, the login name is displayed in the Status Bar and you are granted access.

Logging Out of the System

Depending upon system configuration, you may be automatically logged out and returned to the **Guest** account once you have completed the current task.

You may also log out of the *Meta*PULSE System manually by using either the Main menu or the Tool Bar.

Using the Main Menu



Select **System** from the Main menu, then select **Logout** from the System menu.

You are logged out of the System and returned to the **Guest** account.

Using the Tool Bar

NOTE

Logging out via the Tool Bar is not available when the Wafer View is displayed. You must return to the Cassette Run View in order to log out using the Tool Bar.

Click on the **[Operator Logout]** button in the Tool Bar. 

You are logged out of the System and returned to the **Guest** account.

Exiting the *Meta*PULSE Operator Program

The *Meta*PULSE System may be configured in such a way as to require you to log in before exiting the *Meta*PULSE Operator program. If the System is configured in this manner, you will be permitted to exit the Operator program only if your login name has specific permission to exit the Operator program.

NOTE

You cannot exit the Operator program if measurements are in progress.

To exit the *Meta*PULSE Operator program, perform the following:

1. Ensure that no measurements are currently in progress and that you are in Run Mode.

2. Select **Exit** from the Main menu.

SECURITY NOTICE

If you do not have permission to exit the program, an error message is displayed.

A message is displayed asking you to verify that you wish to exit.

3. Perform **one** of the following:

   - **To exit the program:** click on **[Yes]**.

     The *Meta*PULSE Operator program exits and you are returned to the OS/2 desktop.

   - **To abort the exit and return to the program:** click on **[No]**.

     You are returned to the program.

Menu Maps

Appendix B

Introduction

This appendix provides menu maps for the *Meta*PULSE Operator program while in Run Mode. The Run Mode Main menu is available from both the Cassette Run View and the Wafer View. The Log Viewer menu is available when viewing measurement data.

Not all menu items are available at the same time. Options that are not currently available will have the associated menu selection grayed out (ghosted).

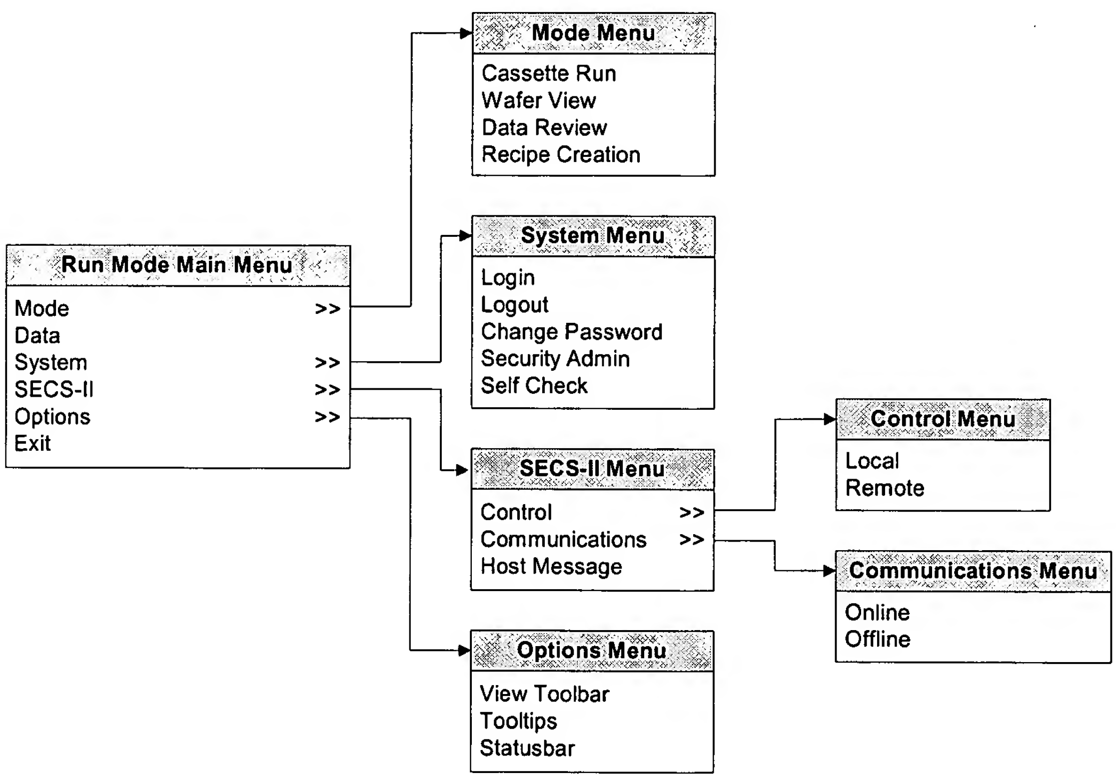


Figure B-1. Run Mode Main Menu (Cassette View and Wafer View)

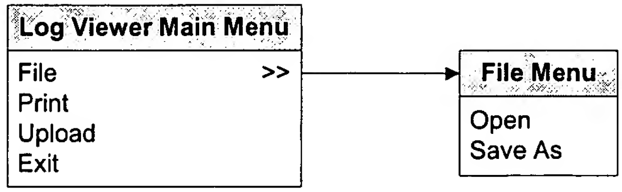


Figure B-2. Run Mode — Log Viewer Menu

Getting Help

Appendix C

In Case of Difficulty

The sections that follow provide some basic information to assist you in identifying problems with your *Meta*PULSE System. If you encounter a software error or hardware malfunction, contact your system Administrator for assistance.

Refer to "Contacting Rudolph Technologies" on page C–6 to get further assistance from Rudolph Technologies Support personnel.

NOTE

Component replacement, repairs, optical alignment, and system calibration should not be attempted without first contacting Rudolph Technologies.

WARNING

Potentially hazardous voltages may be present in the *Meta*PULSE System and Chiller Module. Failure to follow proper safety precautions may result in serious personal injury or death. Electrical problems should be referred to qualified electricians or Rudolph Technologies support personnel.

Use the following table to identify possible problems with your *Meta*-PULSE System. Locate the applicable symptom in the left column of the table to determine the possible causes and recommended actions to rectify the problem.

Table C-1. *Meta*PULSE System Trouble Symptoms

Symptoms	Possible Causes	Recommended Actions
1. Monitor screen is black	Monitor is off. No power to the monitor.	Press the white power button on the front of the monitor.
	Computer is off.	Restart the computer.
2. Operator window does not appear on the screen	Operator program is not running.	Double click the **Operator** icon from the RTI Applications folder. Wait for the software to load.
3. OS/2 icon does not appear in the Minimized Window Viewer—Icon View	OS/2 window is not open.	Click once on the OS/2 button on the desktop toolbar (bottom of the OS/2 desktop).
4. Cannot open Operator program	Calibration program is running.	Double click the **Calibration** icon. Log in with the proper password. Exit Calibration. Double click the **Operator** icon. Wait for the software to load.
	Setup program is running.	Double click the **Setup** icon. Log in with the proper password. Exit Setup. Double click the **Operator** icon. Wait for the software to load.
	Hardpipe Error.	Reset the computer. Wait for the software to load. Double click the **Operator** icon. Wait for the software to load.
5. Tool communication to station controller does not take place	Tool is in local mode.	Verify that the tool is Online in the Operator program. Select **SECS-II** from the Main menu, then **Control** from the SECS-II menu. Select the **Remote** option.
	*Meta*PULSE SECS-II software is not running.	Check the Minimized Window Viewer—Icon View. Double click the **SECS-II** icon in the RTI Applications folder if the SECS-II application is not already running.
6. Cannot queue a cassette plate	Cassette is not properly loaded.	Check that the cassette is seated properly and that it is on the correct cassette plate.
	Cassette is warped.	Remove wafers to a new cassette.
7. Robot will not pick up the correct wafer	Cassette slot or recipe specified is wrong.	Check that the correct recipe has been selected. Check that the proper wafer slots are occupied.
	Robot is not initialized.	Open **RRTest.** Login with the proper password. Press **Return** twice. At the Command prompt type "**inr**" and wait while the robot initializes (approximately one minute).
	Cassette plate/Tilter is not aligned.	Use the alternate cassette plate/tilter. Contact Rudolph personnel.
	Robot failure.	Contact Rudolph personnel.

Continued on next page

Table C-1. *Meta*PULSE System Trouble Symptoms (Continued)

Symptoms	Possible Causes	Recommended Actions
8. *Meta*PULSE Modeling Application crashed in the middle of a run. This has occurred if the *Meta*PULSE Modeling icon does not appear in the Minimized Window Viewer—Icon View.	Cassette slot or recipe specified is wrong.	Check that the correct recipe has been selected and/or the proper wafer slots are occupied.
	Selected recipe was wrong.	Exit Operator and Mpmodapp. Open the OS/2 window. Change to the **d:\rtiapps\bin** subdirectory and type, "**start mpmodapp**". Wait 10 seconds for the software to load. The **Modeling** icon should appear in the Minimized Window Viewer—Icon View window. Restart Operator. Select a different cassette of recipes.
	Wafer may be misprocessed or out of control.	Contact Rudolph Technologies to inspect raw data.
9. Printer is printing blank pages or pages with missing colors.	Printer cartridge is empty.	Check both printer cartridges. Replace either one if necessary with spare cartridges.
10. Printer is not printing.	Printer is out of paper.	Refill paper tray. Bring the printer back on-line.
	Printer is off-line.	Check power and parallel cables to printer. Bring the printer on-line. Refer to the documentation provided with the printer for information.
11. Cannot save file to disk.	Hard disk space is too low.	Save files temporarily to the **e:\temp** directory or to a blank floppy or Jaz disk. Inform Rudolph personnel.
12. Cannot save **s1.mes** file or **s1.mes** file is very small.	**Log Data** switch is on.	Open the *Meta*PULSE Acquisition Application. Turn Log Data Switch Off (no check mark should be displayed).
	s1.mes file is not in the current directory or wrong disk is selected.	Change the directory to the **d:\rtiapps\bin** subdirectory.
	Hard disk space is too low.	Save files temporarily to the **c:\temp** directory. Inform the appropriate personnel.
13. Data displays very large fit errors.	Wrong recipe is selected.	Abort the current cassette run. Select a different recipe.
14. Data displays solver errors.	Wrong recipe is selected.	Abort the current cassette run. Select a different recipe.
	Wrong wafer is being measured.	Verify that the wafer being measured is appropriate for the selected recipe.
	Wafer may be misprocessed or out of control.	Contact Rudolph Technologies to inspect raw data.
15. Computer freezes.		Power down the computer. Eject any floppy and/or Jaz disks. Restart the computer. Wait for the software to load. Double click the Operator icon. Wait for the software to load.

Continued on next page

Table C-1. *Meta*PULSE System Trouble Symptoms (Continued)

Symptoms	Possible Causes	Recommended Actions
16. Computer freezes with a wafer on the stage.		Power down the computer. Eject any floppy and/or Jaz disks. Restart the computer. Wait for the software to load. Double click the Operator icon and follow instructions for unloading the wafer from the stage by choosing the proper cassette and slot number. **Caution: The tool will not remember the proper slot number. Double check that the destination slot is correct before unloading wafer.**
17. Robot will not move.	Robot is not initialized.	Open **RRTest**. Login with the proper password. At the Command prompt, type "**inr**" and wait while the robot initializes (approximately one minute).
	Robot has failed.	Contact Rudolph personnel.
18. Stage will not move.	Stage is not initialized.	Open **RRTest**. Login with the proper password. At the Command prompt, type "**ins**" and wait while the stage initializes (approximately 25 seconds).
	Stage communication is lost.	Turn the green Power On/Off button off, wait 10 seconds. Press the Power On/Off button again to turn the power back on. Press the reset button on the computer. Wait for the software to load. Open **RRTest**. Login with the proper password. At the Command prompt, type "**ins**" and wait while the stage initializes (approximately 25 seconds). If problem persists, contact Rudolph personnel.
	Stage has failed.	Contact Rudolph personnel.
19. System freezes with no wafer inside.		Turn the green Power On/Off button off, wait 10 seconds. Press the Power On/Off button again to turn the power back on. Press the reset button on the computer. Wait for the software to load. Open **RRTest**. Login with the proper password. At the Command prompt, initialize the stage (**ins**), and initialize the robot (**inr**). If either the stage or the robot fails to initialize or if the laser does not return to mode-locked power, contact Rudolph personnel.

Continued on next page

Table C-1. *Meta*PULSE System Trouble Symptoms (Continued)

Symptoms	Possible Causes	Recommended Actions
20. System is shutdown with wafer on stage.		Open manual load door on the front of the tool. Slide the mini-environment top cover forward. Unload the wafer manually with a vacuum wand and return it to a cassette. Close the mini-environment top cover and the manual load door. If the wafer is too far to reach, close the mini-environment top cover and the manual load door. Open the wafer load door next to the robot, remove the wafer with a vacuum wand and return it to a cassette. Close the pulse door. **Note: The system will not function without all wafer doors closed.**
21. Programs are running very slowly.	Print screen key was depressed.	Double click the printer icon. Click on any pending print jobs. Right click on a selected print job and delete the print job. Repeat as necessary.
22. Cannot find a wafer report file.	Wrong **.log** file name selected.	Verify that you are using the correct filename for the desired wafer report.
	Wrong directory.	Change directory to **d:\rtiapps\data**.
	Report was not saved.	Open **Operator**. Select **Data** from the Menu bar. Open the report corresponding to the date and time that the desired cassette was run. Save the report file. Exit the wafer report screen. Cancel the Data view window.
	Report was not saved and/or has been overwritten.	Provide a system administrator with a copy of the raw data file for remodeling the data off-line.
23. Cannot find a raw data file.	Wrong **.mes** file selected.	Verify that you are using the correct filename for the raw data file.
	Wrong directory.	Verify that you are in the proper data directory and subdirectory.
	Data was never saved.	Remeasure the wafers.

Contacting Rudolph Technologies

For additional information and support, contact Rudolph Technologies directly or through an authorized representative in your area. Contact information is provided in the following table.

Item	Information
Phone Number	(973) 691-1300
Fax Number	(973) 691-5480
Address	One Rudolph Road PO Box 1000 Flanders, NJ 07836

NOTE

Before contacting Rudolph Technologies, please obtain the Serial Number of your *Meta*PULSE System. This will help Rudolph Technologies personnel to expedite serving you.

The Serial Number is located on the front of the AC power chassis (lowest rack mount chassis behind the left access door beneath the keyboard).

Glossary

A | B | C | D | E | F | G | H | I | J | K | L | M | N | O | P | Q | R | S | T | U | V | W | X | Y | Z

— A —

Action Bar
Located near the bottom right portion of the screen in certain operating modes, the buttons available on the Action Bar allow for the control of the current process (e.g. start, stop, skip, and/or abort measurements), or allow for quick access to certain control functions (e.g. view, map, graph, print, and/or export data).

Administrator
Individual(s) responsible for configuring system hardware and software, setting up system user logins, passwords, and groups, and performing other administrative tasks (such as database backup).

Analysis
The data reduction routines applied to the measurements.

Application
A film measurement requirement.

— B —

Barcode Reader
A device used to scan the identification code on the bottom of each wafer.

Batch
A numbered group of wafers.

— C —

Calibration Program
Used by Rudolph personnel to calibrate the *Meta*PULSE System.

Cassette
A container for transporting and storing wafers. Also referred to as a Wafer Cassette.

Cassette Plate
The plate on which a wafer cassette is placed. Cassette plates contain sensors to automatically determine the size of a cassette that has been placed upon it. *Meta*PULSE 200 Systems are configured with two cassette plates. *Meta*PULSE 300 Systems may have two cassette plates, or one or both of the cassette plates may be replaced by a Load Port. For the purposes of this guide, the terms "Cassette Plate" and "Load Port" are used interchangeably.

Cassette Recipe
The instructions for performing measurements on a cassette. Each Cassette Recipe consists of one or more wafer recipes, a transfer specification, and a control specification.

Chiller Module
A closed-loop water recirculator that is used to stabilize the temperature of critical components inside the laser.

Chip
One integrated circuit on the wafer. Also referred to as a Die. In this guide, "Chip" and "Die" are used interchangeably.

Control Specification
Part of a Cassette Recipe. The Control Specification specifies which parameters (if any) will be deferred to the Operator at run time, how wafer IDs will be generated, how long measurement data will be retained in the measurement database, and the number of times the Cassette Recipe will repeat.

— D —

Data Combination
A function of Data Review Mode which allows difference, removal rate, and averaging operations to be performed on selected measurement data.

A | B | C | D | E | F | G | H | I | J | K | L | M | N | O | P | Q | R | S | T | U | V | W | X | Y | Z

Data Review Mode
Functional mode of the *Meta*PULSE Operator program which allows a Process Engineer to retrieve, view, and print measurement data, and to create wafer maps and graphs, and to perform data combination tasks.

Database
Information stored in a structured, easily retrievable fashion. Consists of the measurement data, calculated parameters, wafer data, wafer materials, and recipe information.

Die
The region on a wafer that defines one integrated circuit (chip).

Dynamic Repeatability
A test to determine the measurement variation of the instrument when measuring the same point on a wafer multiple times, and includes the variations introduced by the mechanical movements of the sample stage.

— E —

Electronics Bay
The lower portion of the measurement mini-environment/module located below the computer keyboard. Contains the system computer, utility connections, and control electronics.

Engineer
See Process Engineer.

— F —

Filmstack (Film Stack)
A template used to represent the materials and parameters expected in the film structure of a particular site on a wafer. Filmstacks are required to model the measured data and produce calculated results.

Flat / Notch Finder (Detector)
A sensing system used to determine centering and radial position of the wafer on the vacuum chuck.

Folder
A grouping of subfolders in the recipe database. Similar to a directory on a computer disk.

— G —

Generated data
The calculated parameters and results of any statistical operations.

Group
See User Group.

— H —

History Log
Log file containing the data from past measurement runs. The number of measurement logs maintained in the history file is configured by the Administrator.

Host
An external computer system that can be used to control the *Meta*PULSE System via an optional SECS-II interface.

— I —

Interlayer
Used to reduce fit errors and to improve order resolution in certain applications.

— L —

Load Port
A *Meta*PULSE 300 System can be configured with cassette plates for open wafer cassettes, or optional pod loaders. A MetaPULSE 200 System can be configured with cassette plates for open wafer cassettes, or optional SMIF loaders. "Load Port" refers to any of these configurations. For the purposes of this guide, the terms "load port" and "cassette plate" are used interchangeably.

Login
A username/password combination that allows the user to access certain functions or perform certain tasks depending upon the privilege levels granted to their user record and the system security configuration.

The term "login" also refers to the act of entering the username/password combination.

— M —

Mapping
A function of Data Review Mode, this allows wafer maps to be created, viewed, and/or edited. Maps may be contour (2D) or topographic (3D).

Material
The physical composition of a film or substrate (e.g., $SiO2$, TiN, AlCu, etc.)

Measurement Mini-Environment/Module
The portion of the *Meta*PULSE System which houses the measurement system (wafer positioning stage, laser and other optical components, vacuum and air control, etc.) On a *Meta*PULSE 300 System, this is an integrated mini-environment.

Measurement Database
Contains the measurement data for processes that have been run. The measurement data is then accessed and viewed and/or manipulated with the Operator program in Data Review Mode.

Menu Bar
Located near the top of the screen, the menu bar displays the items or commands that can be selected or activated in the current window. Items that are unavailable are ghosted and cannot be selected.

Microscope
Used to provide magnified views of the wafer in the Site Locator (Live Video) window.

Monitor Wafer
An unpatterned wafer.

— O —

Operator
Individual(s) responsible for placing wafers on and removing wafers from the system, selecting the applicable Cassette Recipe, and starting the measurement run.

Operator Program
An integrated, multi-functional, graphical user interface (GUI). The three main operating modes of the Operator program allow you to create filmstacks and recipes (Recipe Creation Mode), select and run recipes to perform wafer measurements (Run Mode), and to retrieve the measurement data (Data Review Mode).

Owner
Individual(s) who are responsible for (own) items stored in the recipe database (e.g. folders, subfolders, cassette recipes, wafer recipes, materials, etc.) Owners determine the security permission levels for their items and grant or deny access to the item on a user group basis.

— P —

Patterned Wafer
A wafer having integrated circuits or precursor etched patterns on its surface.

Process Engineer
Individual(s) responsible for creating and modifying the filmstacks and wafer recipes that are then combined with transfer and control specifications to make up a Cassette Recipe. Additional functions include retrieval and manipulation of measurement data, and the creation/modification of templates to be used in filmstacks and wafer recipes.

— R —

Recipe
See Wafer Recipe.

Recipe Creation Mode
Functional mode of the *Meta*PULSE Operator program which allows a Process Engineer to create, test, and/or modify filmstacks, wafer recipes, and templates.

Recipe Database
Contains the templates, materials, filmstacks, and recipe information used to perform wafer measurements.

Registration
Used for patterned wafers to accurately determine chip size and wafer position (deskew).

A | B | C | D | E | F | G | H | I | J | K | L | M | N | O | P | Q | R | S | T | U | V | W | X | Y | Z

Repeatability
Statistical spread of repeated measurements.

Report
See Wafer Report.

Robot Arm
Electro-mechanical device used to transport wafers to and from wafer cassettes/pod loaders and the wafer positioning stage.

Robot Mini-Environment/Module
The portion of the *Meta*PULSE System which houses the wafer handling robot arm, cassette plates, load ports, and control electronics. On a *Meta*-PULSE 300 System, this is an integrated mini-environment.

Run Mode
Functional mode of the *Meta*PULSE Operator program which allows an Operator to select a cassette recipe in order to perform measurements on wafers.

— S —

SECS Interface
Optional hardware package that allows the *Meta*-PULSE System to be remotely controlled by a host computer via a SECS-I (RS-232C) or HSMS (TCP/IP) connection.

SECS-II Program
Program used to configure and control the optional SECS-II interface.

Setup Program
Program used to configure and customize the *Meta*PULSE System. With this program, the Administrator sets system default values, configures system security features, and performs certain database related tasks (backup and restore).

Static Repeatability
A test to determine the measurement variation of the instrument when measuring the same point on a wafer several times, and does NOT include the variations introduced by the mechanical movements of the sample stage.

Status Bar
Located at the bottom of the screen, the status bar provides pointer help, an indication of the current system status (ready, running process, etc), the SECS-II communications status (online/offline, local/remote), the login name of the individual currently logged in, and the current system time.

Stepper Group
The chips contained within one exposure of the stepper. Normally each stepper group on a wafer is identical although the chips within the stepper groups may not be.

Subfolder
Contained within a folder, a subfolder is a grouping of cassette recipes in the recipe database. Similar to a subdirectory on a computer disk.

— T —

Template
Used as building blocks for wafer recipes. Consists of a data component (i.e., filmstack, transfer specification, and wafer report), containing a unique data configuration.

Title Bar
Located at the top of the screen, the title bar provides an indication of the version of the *Meta*PULSE Operator program that is running, as well as the current mode of operation.

Tool Bar
Located near the top of the screen, the tool bar consists of buttons that allow for quick access to certain system functions (such as changing the mode of operation, logging in and out, and controlling a measurement run).

Transfer Specification
Template used to identify the source and destination cassette locations, the cassette slots containing the wafers to be measured, cassette mapping functions, and the cassette to which wafers will be returned if measurements are rejected.

A | B | C | D | E | F | G | H | I | J | K | L | M | N | O | P | Q | R | S | T | U | V | W | X | Y | Z

— U —

Unpatterned Wafer
A template used to specify the measurement pattern for unpatterned wafers. Recipe made for monitor wafer applications.

User Group
A grouping of user records. Each user belongs to one or more group. Security permission levels are assigned to each group, these permissions are then transferred to each member of the group.

User Interface
The station from which the *Meta*PULSE System is controlled. Consists of the power controls, video display, keyboard, and pointing device.

User Record
The profile for an individual user. Consists of the user name, password, basic privileges allowed (access to certain operating modes, creation of recipe items, shutting down the Operator program, and deleting recipe items), and a list of the user groups of which the user is a member.

— W —

Wafer Cassette
See Cassette.

Wafer Recipe
A set of instructions to describe the measurement of a wafer.

Wafer Report
A template used to control the output format of the measured data.

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RUDOLPH
Technologies, Inc.

Operating Your
***Meta*PULSE System**

Part Number: A16203
Issue Date: April 22, 1998

Your opinion is important to us ...

Rudolph Technologies welcomes your feedback on this document and encourages you to complete and return this form to us, together with any additional comments or suggestions you may have.

Your comments can be of great value in helping us to improve our documentation.

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*Meta*PULSE™

Administrator's Guide

Part No. A17945
Revision A
9/4/98

RUDOLPH
Technologies, Inc.

One Rudolph Road
Flanders, NJ 07836

DISCLAIMER

Every attempt has been made to make this manual complete, accurate, and current. Users are cautioned, however, that Rudolph Technologies, Inc. reserves the right to make improvements and changes without notice and shall not be responsible for any damages (including consequential) caused by reliance on the material presented, including, but not limited to, typographical, arithmetical, or listing errors.

Trademarks

Revision History

This page provides a revision history for this manual.

Rev.	Date	Description
A	9/4/98	Original release providing administration information for *Meta*PULSE 200 and 300 systems running VANGUARD software version 6.32 or greater.

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About This Guide

Introduction

This guide provides detailed information to aid a System Administrator in setting up and configuring the hardware and user accounts for *Meta*PULSE 200 and *Meta*PULSE 300 Systems.

About This Guide

Describes the purpose, structure, and intended audience of this guide.

Chapter 1 — System Overview

Provides an overview of the hardware components that make up the *Meta*PULSE System.

Chapter 2 — System Configuration

Provides information on how to configure the *Meta*PULSE System including hardware configuration and system security (configuring logins, groups, and passwords).

Appendix A — Starting and Stopping the System

Describes how to start up and shut down the *Meta*PULSE System. Procedures are provided for normal start up and shut down, emergency shut down, and for recovering from an emergency shut down.

Appendix B — Menu Maps

Provides menu maps for the *Meta*PULSE System software.

Appendix C — Getting Help and Troubleshooting

Provides a listing of error messages that may occur during system operation, basic troubleshooting and problem resolution procedures, and information on how to contact Rudolph Technologies for support.

Appendix D — Preventive Maintenance

Provides *Meta*PULSE system preventive maintenance procedures including backing up and restoring database information.

Glossary

Provides definitions of commonly used terms.

Intended Audience

This guide is mainly intended for the **System Administrators** who are responsible for system configuration and security of the *Meta*PULSE System.

Related Manuals

Other relevant Rudolph publications include:

- **Operating Your *Meta*PULSE™ System**
(Part Number A16203). Provides detailed information on how to operate the *Meta*PULSE System in Cassette Run Mode. Describes how to select and run Cassette recipes to perform wafer measurements.
- ***Meta*PULSE™ Applications Development Guide**
(Part Number A17994). Provides detailed information on how to create, test, and modify filmstacks and recipes that are used to measure wafers. Describes saving, retrieving, and manipulating measurement data, and how to edit the recipe database.
- ***Meta*PULSE™ 200 System Facility Requirements Manual**
(Part Number A15984). Describes considerations that need to be addressed prior to shipment and installation of a *Meta*PULSE 200 System.
- ***Meta*PULSE™ 300 System Facility Requirements Manual**
(Part Number A17116). Describes considerations that need to be addressed prior to shipment and installation of a *Meta*PULSE 300 System.
- **VANGUARD™ SECS-II/GEM Interface Specifications**
(Part Number A17792). Describes the SECS-II/GEM interface.
- Additional documentation as provided by Rudolph Technologies.

Usage and Conventions

The following table shows some of the conventions used in this guide.

Term or Phrase	Meaning
***Meta*PULSE** or **System**	Unless otherwise specified, the terms "*Meta*-PULSE" and "System" are intended to refer to both the *Meta*PULSE 200 and *Meta*PULSE 300 System.
Bold	Bold text identifies menu or field names (for example, **Mode** menu or **Name** field) and any other text that may require particular attention.
[Bold]	Bold text within square brackets identifies window buttons (for example, click on **[Enter]**).
Click or **Select**	These terms imply a single press and release of the LEFT button on the pointing device (mouse or trackball) with the cursor positioned over the specified object (for example, select the desired filmstack from the list then click on **[Enter]**).
Double Click	Unless otherwise stated, this term implies the press and release of the LEFT button on the pointing device twice in quick succession with the cursor positioned over the specified object.
Right Click	This term implies a single press and release of the RIGHT button on the pointing device.
View or **Window**	The terms "View" and "Window" are used interchangeably in this guide and refer to a window that is displayed on the system monitor.
Cassette Plate or **Load Port**	The terms "Cassette Plate" and "Load Port" are used interchangeably in this guide.

Admonishments

Admonishments are used to make certain information stand out from the surrounding text in order to be brought to your attention. Special attention should be paid to the following types of admonishments used in this guide:

- Notes
- Cautions
- Warnings
- Security Notices

Notes

Notes provide important or explanatory information that stands out from the rest of the text. Notes are presented in the following manner:

NOTE

For security reasons, asterisks (*) will be displayed as you enter your password.

Cautions

Cautions indicate the presence of a hazard that will or can cause property damage (such as equipment damage, loss of software/data, or service interruption) if the hazard is not avoided. Cautions are presented in the following manner:

CAUTION

Modifying an existing transfer control will affect all recipes that use that transfer control.

Warnings

Warnings indicate the presence of a hazard that will or can cause personal injury if the hazard is not avoided. Warnings are presented in the following manner:

WARNING

Potentially hazardous voltages may be present in the *Meta*PULSE System and Chiller Module. Failure to follow proper safety precautions may result in serious personal injury or death. Electrical problems should be referred to qualified electricians or Rudolph Technologies support personnel.

Security Notices

Security notices indicate a procedure or condition that could impact the security of the recipe database or measurement data.

SECURITY NOTICE

To maintain system security, it is important to remember to log out of the system when you have completed your tasks. Failure to do so may allow unauthorized users to have access to the recipe database and measurement data.

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System Overview

Chapter 1

Introduction

This chapter provides brief descriptions of the *Meta*PULSE 200 and *Meta*PULSE 300 System hardware and software, and is intended to be a high level overview of the *Meta*PULSE System. Detailed operating instructions are provided in later chapters of this guide and in other referenced documentation.

The topics covered in this chapter include:

NOTE

It is assumed that the reader has a basic knowledge and understanding of a computer graphical user interface and the basic functionality and use of a trackball/mouse pointing device.

Hardware Overview

The sections that follow provide descriptions of the hardware that make up *Meta*PULSE 200 and *Meta*PULSE 300 Systems.

*Meta*PULSE 200

The *Meta*PULSE 200 System is designed to be operated in a ballroom configuration. The major assemblies that make up the *Meta*PULSE 200 System are listed below and are shown in Figure 1-1. Descriptions of each of the assemblies follow the figure.

- **Measurement Module**
- **Robot Module**
- **External Chiller Module (Figure 1-4 on page AD 1–10)**

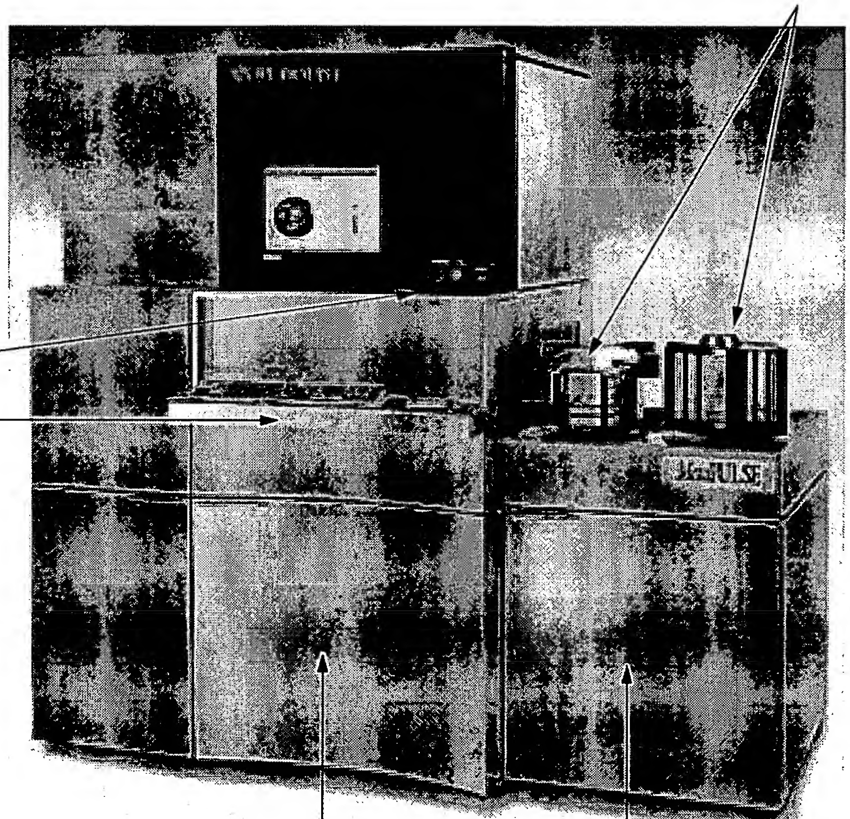


Figure 1-1. *Meta*PULSE 200 System

Measurement Module

The Measurement Module consists of the power control panel, measurement system (laser assembly and other optical components, wafer positioning stage, etc), computer system, and control electronics that provide the means to accurately measure layer thickness and interface characteristics (such as missing layers, adhesion, interlayer chemical reactions, RMS roughness of surface and buried layers, and material properties such as silicide phase).

Measurement System

The measurement system includes components that are involved in performing the film measurements (wafer positioning stage, laser, microscope, and other optical components).

Once a wafer is loaded onto the wafer positioning stage, it is detected and held in place by the vacuum control system. The stage moves the wafer along the X and Y axes to position the desired measurement location under the laser focal point. Once properly positioned, the optical components perform the measurements as determined by the selected recipe. Low pressure air is used to provide vibration isolation while measurements are being taken.

Control Electronics

The control electronics include all of the electronic control modules (including rectifiers, transformers, and motion control circuitry) that power the *Meta*PULSE System and contain the logic and drivers for all motion of the stage and vacuum chuck.

Computer System

The computer system is used to set up measurements and calculate the data results. It consists of an IBM®-compatible PC running the *Meta*PULSE software on the OS/2® operating system. A VGA display (with live video overlay), pointing device (either a mouse or trackball), Iomega® Jaz™ drive, CD-ROM drive, and 3.5" floppy drive are also part of the computer system.

An I/O subpanel provides connections for an optional color printer or SECS interface.

Power Controls

A power control panel is located on the Measurement Module that allows you to turn the *Meta*PULSE 200 System on and off under both normal and emergency conditions.

Robot Module

The Robot Module consists of the load ports, wafer handler robot, and robot control electronics.

Wafer Handler Robot

A wafer handler robot is used for programmed access and transport of wafers to and from wafer cassettes positioned on the load ports and the wafer positioning stage in the Measurement Module.

Load Ports

In a standard configuration, the *Meta*PULSE 200 System has two open cassette plates. As an option, the two cassette plates can be replaced by two SMIF Loaders. In either configuration, the cassette plates or SMIF Loaders are also referred to as "load ports".

Each load port is capable of handling 200mm (8 inch) wafer cassettes.

*Meta*PULSE 300

The *Meta*PULSE 300 System is designed to be operated in either a ballroom or through-wall configuration. The major assemblies of the *Meta*PULSE 300 System are listed below and shown in Figure 1-2 and Figure 1-3. Descriptions of each of the assemblies follow the figures.

- **Main User Interface**
- **Optional User Interface Module (not shown in the figures)**
- **Measurement Mini-Environment**
- **Robot Mini-Environment**
- **Load Ports**
- **External Chiller Module (Figure 1-4 on page AD 1–10)**

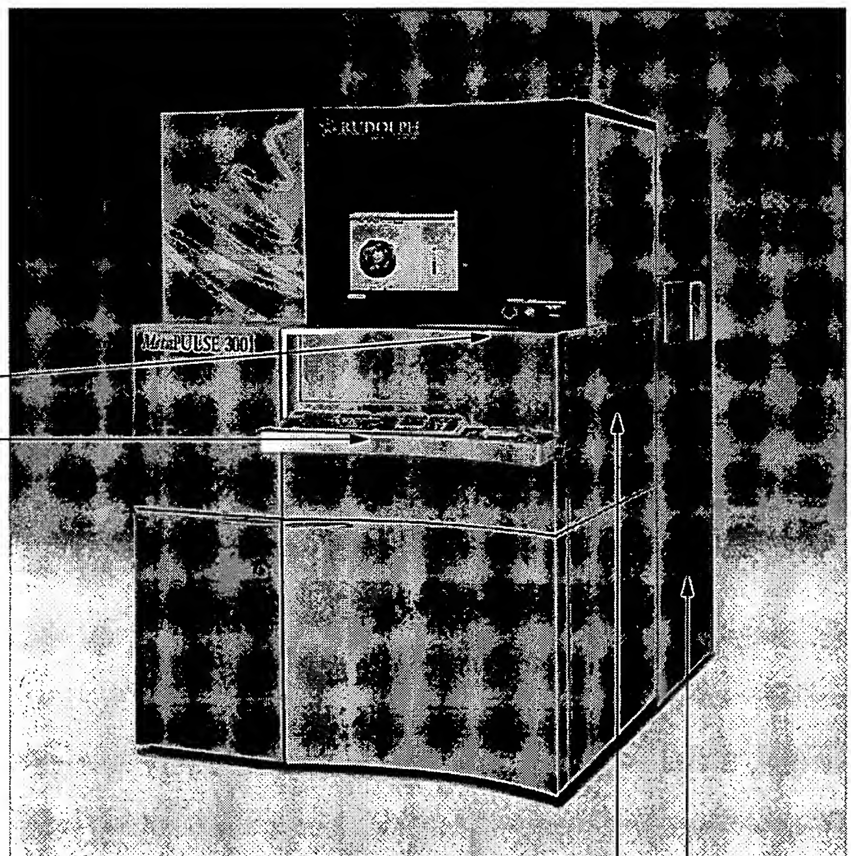


Figure 1-2. *Meta*PULSE 300 System — Chase Side (Rear)

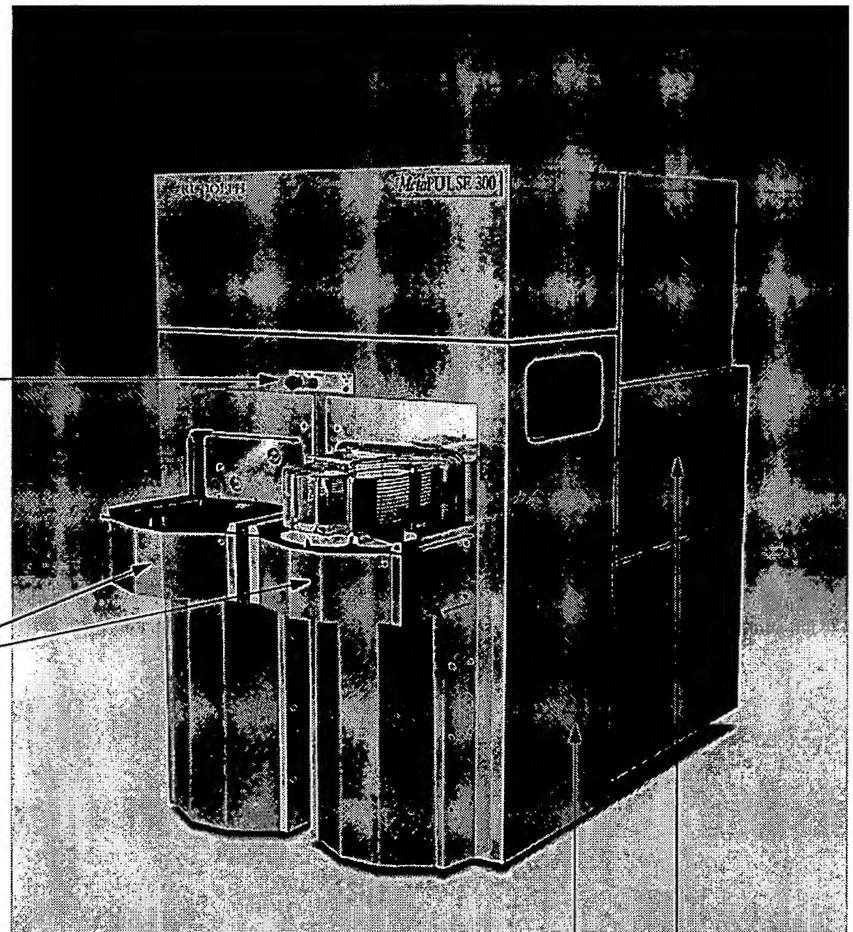


Figure 1-3. *Meta*PULSE 300 System — Cleanroom Side (Front)*

* System shown is configured with optional dual Front Opening Unified Pods (FOUPs).

Main User Interface

Located on the rear of the *Meta*PULSE 300 System (chase side in a through-wall configuration), the Main User Interface consists of the computer system (including display, pointing device, and keyboard) and power controls for the system. This is the primary station from which the system is operated.

Computer System

The computer system is used to set up measurements and calculate the data results. It consists of an IBM-compatible PC running the *Meta*PULSE software on the OS/2 operating system. A VGA display (with live video overlay), pointing device (either a mouse or trackball), Iomega Jaz drive, CD-ROM drive, and 3.5" floppy drive are also part of the computer system.

An I/O subpanel provides connections for an optional color printer and/or SECS interface.

Power Controls

A power control panel, consisting of a Power On/Off switch and Emergency Machine Off (EMO) switch, is located on the Main User Interface. These switches allow you to turn the *Meta*PULSE 300 System on and off under both normal and emergency conditions.

An additional power control panel is located on the front (cleanroom side in a through-wall configuration) directly above the load ports. An Emergency Machine Off (EMO) switch is available on this power control panel.

Optional User Interface Module

An optional User Interface Module that consists of a VGA display, keyboard, pointing device, and Power On/Off switch, may be attached to the right side of the *Meta*PULSE 300 System (as viewed from the front, or cleanroom side in a through-wall configuration).

The optional User Interface Module allows the system to be operated from either the front or rear of the unit.

Measurement Mini-Environment

The Measurement Mini-Environment is an integrated mini-environment designed to meet Class 0.01 specifications.

The measurement system and control electronics that make up the Measurement Mini-environment provide the means to accurately measure layer thickness and other filmstack characteristics (such as missing layers, adhesion, interlayer chemical reactions, RMS roughness of surface and buried layers, and material properties such as silicide phase).

Measurement System

The measurement system includes vacuum and air control, a wafer positioning stage, and a laser and other optical components that actually perform the film measurements.

Once a wafer is loaded onto the wafer positioning stage, it is detected and held in place by the vacuum control system. The stage moves the wafer along the X and Y axes to position the desired measurement location under the laser focal point. Once properly positioned, the optical components perform the measurements as determined by the selected recipe. While measurements are being taken, low pressure air is used to provide vibration isolation.

Control Electronics

The control electronics include all of the electronic control modules (including rectifiers, transformers, and motion control circuitry) that power the *Meta*PULSE System and contain the logic and drivers for all motion of the stage and vacuum chuck.

Robot Mini-Environment

The Robot Mini-Environment is an integrated mini-environment designed to meet Class 0.01 specifications and consists of the wafer handler robot and robot control electronics.

Wafer Handler Robot

A wafer handler robot is used for programmed access and transport of wafers to and from wafer cassettes positioned on the load ports and the wafer positioning stage in the Measurement Mini-Environment.

Load Ports

In a standard configuration, the *Meta*PULSE 300 System has two open cassette plates that are located on the front of the unit (or cleanroom side in a through-wall configuration). As an option, one or both of the cassette plates can be replaced by a Front Opening Unified Pod (FOUP) Loader. In either configuration, the cassette plates or Pod Loaders are also referred to as "load ports".

Each cassette plate can accept 200 or 300mm wafers in open wafer cassettes, or 300mm wafers in pods if the optional Pod Loader(s) have been ordered.

Sensors on the open cassette plates automatically determine the size of the wafer cassette that has been placed upon the plate.

External Chiller Module

The External Chiller Module, used by *Meta*PULSE 200 and *Meta*PULSE 300 Systems, is a closed loop water recirculator used to stabilize the temperature of critical components inside the ultrafast laser.

The unit uses de-ionized or distilled water and consists of a non-CFC air-cooled refrigeration system, circulation pump, seamless stainless steel bath, work area cover, and a temperature controller.

The Chiller can be located in the sub-Fab no more than 12.2 meters (40 feet) below the *Meta*PULSE unit. Locating the Chiller in the chase is preferred for ease of access.

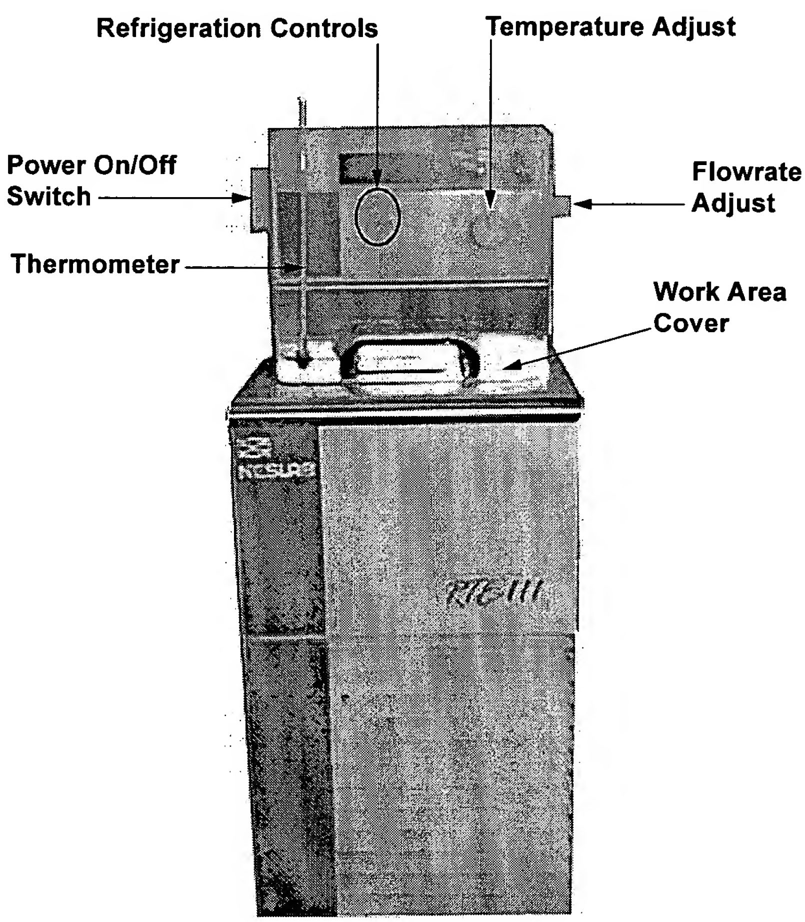


Figure 1-4. External Chiller Module

Optional Equipment

This section describes the options that can be purchased from Rudolph Technologies for use with the *Meta*PULSE 200 and *Meta*PULSE 300 Systems.

The following options are available:

- Bar Code Reader
- Signal Tower
- Pattern Recognition
- Color Printer
- Floor Mounting
- GEM Compliant SECS-II
- Alternate Load Port Configurations
- Cassette Mapping and Cross Slot Detection

Bar Code Reader

The optional bar code reader can be used to scan the identification code on the bottom (or top if so specified when the system was ordered) of each wafer.

Signal Tower

The signal tower option is an array of colored lights and an audible alarm which provide an easy indication of the status of the *Meta*PULSE System. The meaning of each light in the signal tower is programmable through the *Meta*PULSE Setup program.

Pattern Recognition

The Pattern Recognition system allows for automatic fine alignment of the wafer's position on the stage allowing automated small site measurements.

Color Printer

An optional color printer may be connected to the *Meta*PULSE System to print wafer maps and measurement data reports. The printer parallel cable is attached to the Printer connector on the I/O subpanel.

NOTE

Additional power must be supplied for the printer.

Floor Mounting

There are two types of unit mounting:

1. Standard Hard Feet (Levelers)

   Hard feet that screw into the bottom of the *Meta*PULSE System lift and level the unit.

2. Optional Earthquake Security Hardware

   In those areas where the equipment should be secured against seismic movement, an optional earthquake kit is available to fasten the *Meta*PULSE System to the floor. This optional earthquake security hardware can be ordered from Rudolph Technologies.

GEM Compliant SECS-II

The GEM compliant SECS-II option consists of software and hardware that allows the *Meta*PULSE System PC to communicate with a remote mainframe host.

One of two connection options must have been selected at the time of system purchase:

- **SECS-I RS-232 Option** — comprised of software and hardware for communication via a 25-pin serial connector. This connector is described in ISO 2110-1980.

  When this option is purchased, an RS-232 cable is attached to the RS-232 SECS connector on the I/O subpanel.

- **HSMS (TCP/IP) Option** — comprised of software and hardware for 10baseT ethernet communication.

  When the HSMS option is purchased, the ethernet UTP cable RJ-45 connector is attached to the I/O subpanel.

NOTE

SECS-II simulation software, which runs on a stand-alone PC, is also available from Rudolph Technologies upon request.

Alternate Load Port Configurations

Each *Meta*PULSE System comes with a standard load port configuration consisting of two open cassette plates. As an option, the *Meta*PULSE System may be configured with any of the load port configurations listed below:

- Dual SMIF I/O (*Meta*PULSE 200 only)
- Tilt Cassettes with Work Surface (*Meta*PULSE 200 Open 200mm Cassette only)
- Dual 300mm Front Opening Unified Pod (FOUP) I/O (*Meta*PULSE 300 only)
- Single 300mm Front Opening Unified Pod (FOUP) I/O plus Single Open Cassette 300mm I/O (*Meta*PULSE 300 only)

Cassette Mapping and Cross Slot Detection

The Cassette Mapping option optically determines which cassette slots contain wafers, and whether any wafers are cross-slotted (the wafer is not properly seated entirely within one cassette slot and is partially occupying two adjacent slots).

System Safety Features

Each *Meta*PULSE System provides the following safety mechanisms:

- **Laser Safety.** *Meta*PULSE Systems meet or exceed all of the requirements of U.S. Federal Regulation 21CFR1040.00 for a Class I laser product when all doors and access panels to the Measurement Module are closed. No special measures are required to protect the operator from laser radiation under normal operating conditions.

  In certain maintenance modes, service personnel may have access to a Class IV laser product and will need appropriate protective materials. Laser warning labels (shown below) are affixed at several locations on the *Meta*PULSE System:

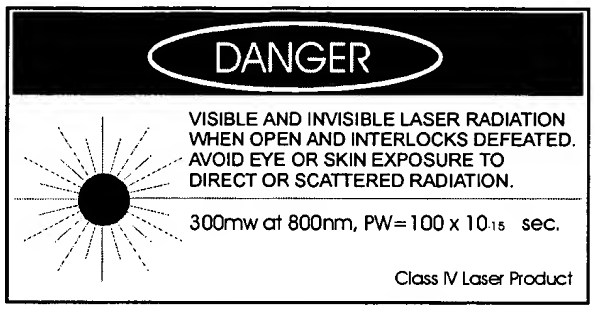


Figure 1-5. Laser Safety Label

NOTE

If special safety modifications are required to comply with international safety standards, please provide Rudolph Technologies with a detailed description of the specific safety requirements. The requirements must be communicated to, and accepted by, Rudolph Technologies prior to placing your final order.

- **Motion and Laser Interlocks.** Several interlocks are built into the *Meta*PULSE System to ensure operator safety.

- **Emergency Shutoff Forces.** An emergency shutoff function is built into the *Meta*PULSE System wafer-handling robot. All robot motion is automatically stopped if an obstacle is encountered.

- **Emergency Machine Off.** An Emergency Machine Off (EMO) switch shuts down the entire system including air flow and the computer. Pilot voltage and the laser internal UPS are not shut down. A vacuum ballast maintains vacuum to the robot arm to hold a wafer (if present) in place. *Meta*PULSE 200 Systems have one EMO switch located to the right of the VGA display. *Meta*PULSE 300 Systems have two EMO switches, one located on the front and one located on the rear of the unit.

*Meta*PULSE Software Overview

The *Meta*PULSE System software applications allow you to setup, calibrate, and run the *Meta*PULSE System, as well as configure the optional SECS interface.

Each application runs under the OS/2 operating system. Both the OS/2 operating system and the *Meta*PULSE software package are pre-installed by Rudolph Technologies.

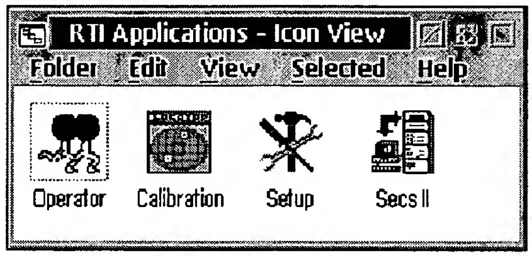


Figure 1-6. RTI Applications Folder (OS/2 Desktop)

SECS-II Program

The **SECS-II** program allows you to configure the optional SECS interface that allows a remote host to control the *Meta*PULSE System.

For more information, refer to VANGUARD™ SECS-II/GEM Interface Specifications (Part Number A17792).

Setup Program

The **Setup** program allows you to configure the *Meta*PULSE System hardware, set system software defaults, and setup system security.

The Setup program is described in Chapter 2. "System Configuration".

Calibration Program

The **Calibration** program allows you to Calibrate the *Meta*PULSE System.

NOTE

The Calibration program is for use by Rudolph Technologies trained and certified engineers and administrators only.

Operator Program

The **Operator** program is an integrated, multi-functional, graphical user interface (GUI) which allows you to create and run recipes, run individual wafers, run cassettes, browse measurement data, map wafer measurement data, and plot wafer measurement data.

Modes of Operation

The *Meta*PULSE Operator program has three integrated modes of operation:

- Cassette Run Mode
- Recipe Creation Mode
- Data Review Mode

The sections that follow provide a description of each mode. For detailed information, and for instructions on how to use the views associated with each mode, refer to the applicable documentation.

Cassette Run Mode

Cassette Run Mode allows you to setup and run Cassette recipes, view the current wafer being measured, and view recent measurement data.

Detailed instructions for operating the *Meta*PULSE System in Cassette Run Mode are provided in Operating Your *Meta*PULSE™ System (Part Number A16203).

Recipe Creation Mode

Recipe Creation Mode allows you to create and/or modify filmstacks, wafer recipes, and templates for use in wafer recipes, and to browse and edit the recipe database.

Detailed instructions for operating the *Meta*PULSE System in Recipe Creation Mode are provided in *Meta*PULSE™ Applications Development Guide (Part Number A17994).

Data Review Mode

Data Review mode allows you to view and manipulate measurement data. The measurement data can be viewed as a summary list, text report, wafer map, and/or graph. Data combination and import/export are also available in this mode.

Detailed instructions for operating the *Meta*PULSE System in Data Review Mode are provided in *Meta*PULSE™ Applications Development Guide (Part Number A17994).

System and Database Security

The *Meta*PULSE System can be configured with varying levels of system security to suit virtually any environment. Security levels range from having all security disabled to requiring each operator to log in with a user name (and optionally, a password) before accessing protected programs, modes, or the recipe/measurement databases.

SECURITY NOTICE

Turning off system security will allow any operator full access to the system, including (but not limited to) the ability to run any Cassette recipe, create and modify recipes, and access and delete measurement data. However, access to the Security Administration functions will still be controlled.

Once an Administrator enables and configures the system security options, the necessary **"user accounts"** and **"user groups"** may then be created.

- Each user account consists of the login name, password, user specific privileges, and group assignments for an individual user.

SECURITY NOTICE

User passwords may be case sensitive depending upon your system configuration.

- Each user group is a logical grouping of one or more users. Users may belong to more than one group. Default security access levels (Read, Write, Execute, and/or Data Write) are assigned to the user group.

After the user accounts and groups have been configured, the recipe database is protected from modification by unauthorized users by assigning an **"Owner"** to each object in the recipe database. The Owner then decides which user group(s) may have access to the item and what privileges (read, write, execute, and/or data write) the members of the groups have for the item.

This security applies to any object in the recipe database including: Folders, Subfolders, Cassette recipes (including any object that may be used in a Cassette recipe, such as wafer recipes, transfer controls, and recipe controls), any object that may be used in a wafer recipe (such as measurement patterns, filmstacks, and wafer information), and any object that may be used in a filmstack (such as material parameters).

By default, the creator of the recipe database object is the Owner. The Owner may then reassign ownership of the item to another user if desired.

SECURITY NOTICE

Changing ownership may prevent you from accessing that Folder, Subfolder, or Cassette recipe once the change is saved.

When you log into the system by selecting your login name (and entering your password if required), the system determines whether or not you may run a particular Cassette recipe, modify the recipe file structure, or delete data (when in Data Review mode).

SECURITY NOTICE

To maintain system security, it is important to remember to log out of the system when you have completed your tasks. Failure to do so may allow unauthorized users to have access to the recipe database and measurement data.

For information on configuring your *Meta*PULSE System to require user log in, and for information on how to create user accounts, assign passwords to users, assign users to groups, and set default access levels for each group, refer to Chapter 2, "System Configuration".

For information on how to set which groups have access to a Folder, Subfolder, or Cassette recipe, and what functions may be performed on those items, refer to *Meta*PULSE™ Applications Development Guide (Part Number A17994).

System Configuration

Chapter 2

Introduction

This appendix provides information on how to configure your *Meta*PULSE System and perform certain administrative tasks.

The topics covered in this chapter include:

SECURITY NOTICE

You must have administrative login security privileges to create and modify user login names and passwords, make group assignments, and assign default security levels.

The *Meta*PULSE System software and hardware is configured through the use of the **Setup** program. This program allows the Administrator to set default options for the hardware and software, as well as perform database backup, restore, and maintenance functions.

NOTE

Refer to Appendix D, "Preventive Maintenance" for procedures on performing the database functions.

Creating and modifying user login names, passwords, and group assignments, and assigning default access security levels is accomplished by using the **Operator** program.

*Meta*PULSE Setup Program

The *Meta*PULSE **Setup** program is used to configure the *Meta*PULSE System hardware, software defaults, and configure system security.

The *Meta*PULSE Setup main window is shown in Figure 2-1. The sections that follow provide a description of the functions available through the Setup program and how to use the Setup program to configure your *Meta*PULSE System.

NOTE

Refer to "Starting the Setup Program" on page AD A–10 for instructions on how to start the Setup program.

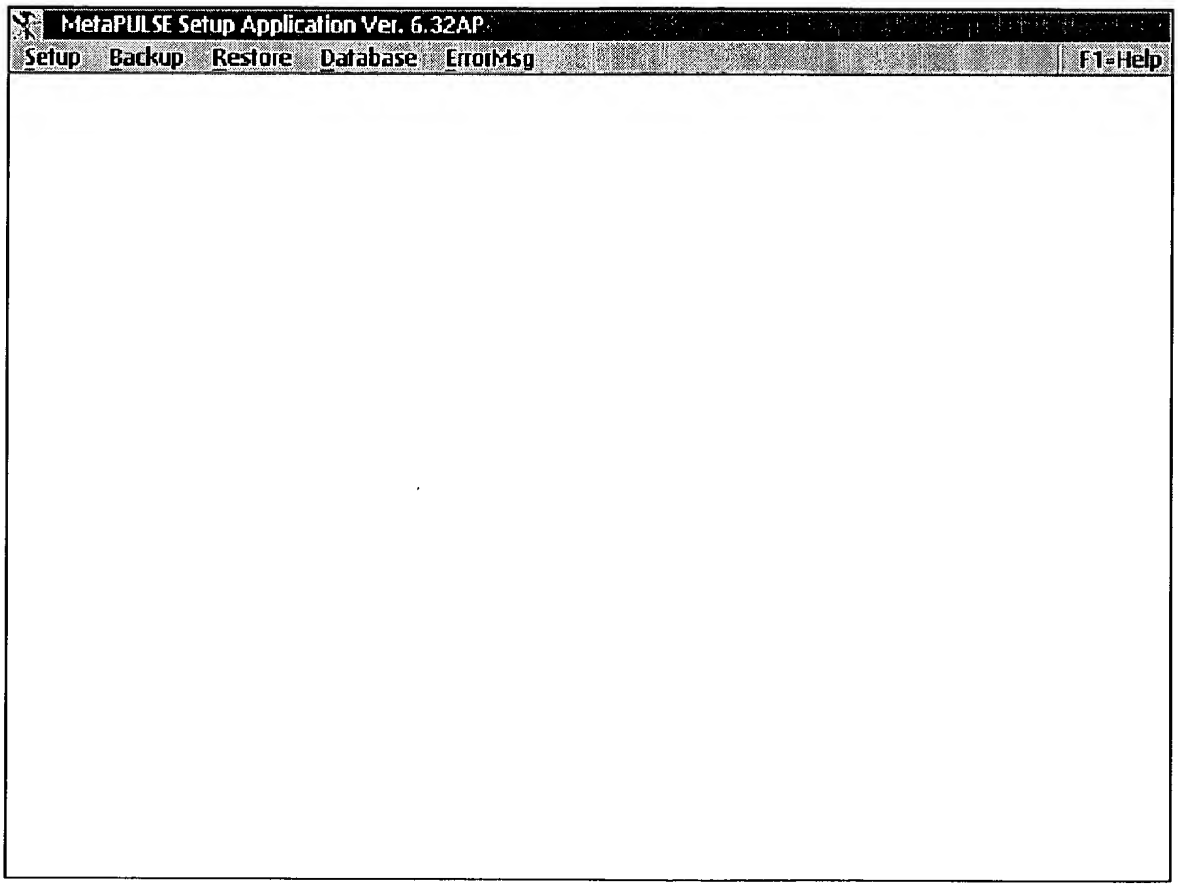


Figure 2-1. *Meta*PULSE Setup Main Window

*Meta*PULSE Setup Main Menu

The *Meta*PULSE Setup Main Menu provides functions that allow you to configure the *Meta*PULSE System, backup and restore selected database files, and add comments to Rudolph error messages.

CAUTION

The *Meta*PULSE System is initially configured by Rudolph Technologies personnel when the system is installed. It is recommended that these settings not be changed unless directed to do so by Rudolph Technical Support.

With the exception of configuring system security information and certain database functions, only brief descriptions of the options available through the Setup program are provided in this section. Contact Rudolph Technologies or your authorized service representative if more detailed configuration information is required.

NOTE

The *Meta*PULSE Setup menu selections will vary depending on your system hardware configuration and software version.

The following menu items are available in the Setup Main window:

- **Setup** — Allows you to access and change any of the following parameters. These parameters include hardware configuration data and default settings for the *Meta*PULSE System software.
  - **Hardware** — Options available from the Hardware menu specify the hardware configuration of the system and include: **Model Number**, **Cassette Mapping**, **Signal Tower**, **Wafer Handler**, and **SMIF**.

    These options specify: type of equipment/model number, type of stage, the type of load ports installed on the system, whether the cassette mapping option is enabled/disabled and when mapping will occur, whether a signal tower is present on the system (and how the signal tower is configured, including enabling or disabling the siren), the wafer handler system defaults (including: stage x and y movement, robot arm, and stage chuck settings), and SMIF setup options (including: tag reader configuration and Indexer/LPO settings).

NOTE

Setting the wafer handler speed values too high may cause the stage/robot to stall.

- **Security** — Specifies whether system security is enabled or disabled. When enabled, system-wide security options are configured such as: one time login, operating mode logins, and whether passwords are required when logging in to the system. Also general security options are specified including: the ability to exit the Operator program and whether passwords entered must be case-sensitive.

- **Simulation** — When enabled (indicated by a mark beside the menu item), the system recognizes that the hardware has been disabled. This allows you to perform certain tasks offline and experiment with filmstacks. No actual measurements can be made in Simulation mode.

NOTE

You must reboot the computer after changing the Simulation setting.

- **Initialization** — Sets how often the system will be initialized. Initialization frequency may be set to every time the *Meta*PULSE System software is started, or only on power-up. With Smart Idle Initialization enabled, the wafer handler may be initialized after a specified number of days, during a given time period after the system has not been used for a specified period of time. Also indicates the last time the system was initialized.

- **Mapping** — Sets the system defaults for viewing wafer maps. Sigma level, grid dimensions, type of map (2D or 3D), color mode, and other display options may be specified.

- **Vision & Video** — Specifies the type of vision system installed and defines the vision and pattern recognition system related parameters.

- **Measurement** — Sets the system measurement defaults including: the default number of test repeats for repeatability testing, delay count, reduction factor, fit tolerance, compensator motor speed, default substrate and ambient layers, and measurement units.

- **Operator** — Sets the default values for the *Meta*PULSE System Operator program. Options include: whether to generate cassette plate information and wafer IDs, the transfer window style, data review and Operator lock on/off, and the default configuration for the SECS-II options.

- **Database** — Enables or disables the saving of wafer measurement data and specifies how long measurement data will remain in the database. Also specifies the media path, which defines the default path for the database import/export function.

- **Data Files** — Specifies the default filenames for the History log and the log that contains the data from the measurement that was last run. Also specifies the log file path, the number of logs that will be stored, the font style for the log viewer, and how the pattern recognition data will be grouped in the log.

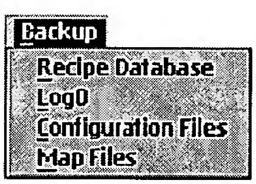
- **Miscellaneous** — Sets the password required to access the RRTest and SECS-II functions. If no entry is made, then no password is required. Also specifies the tool name (which identifies the instrument and is shown in the text when generating a data report), the number of wafer slots per cassette, wafer unload orientation, laser spot target radius, centering tolerances, type of barcode reader, and illumination levels.

- **Recipe Repeat** — Specifies the number of times the selected Wafer Recipe will be run.

- **PM** — Sets the activation/deactivation method of preventive maintenance messages (by wafer count or time). Each of four possible warning messages may have its own specified warning message text. The Current State indicates the state of the message. **Time Activation** can be selected for a Start or a Repeat method. The Start method will activate the message at the time selected. The Repeat method will activated the message every X days. **Wafer Activation** can be selected for a Start or a Repeat method. The Start method will activate the message at the time X wafers have been measured. The Repeat method will activate the message after every X wafers are measured.

- **Throughput** — Used specifically for running throughput tests. Throughput optimizations and logging may also be specified.

- **System Check** — Specifies how often self checks are performed for system alignment, probe detector drift, and phase drift. The action that is taken when a self check is out of tolerance is also selected.



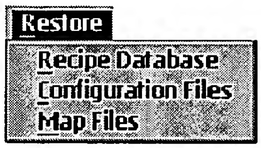
• **Backup** — Allows you to perform system database backup procedures.

  - **Recipe Database** — Backs up the Wafer Recipe database and the Vision System pattern database.

  - **Log0** — Backs up the log0 history file.

  - **Configuration Files** — Backs up configuration files.

  - **Map Files** — Backs up the wafer map files.



- **Restore** — Allows you to restore the system database from backup.
  - **Recipe Database** — Restores the Wafer Recipe database and the Vision System pattern database.
  - **Configuration Files** — Restores the configuration files.
  - **Map Files** — Restores the wafer map files.

- **Database** — Allows you to perform database maintenance tasks.
  - **Vision** — Deletes those image files that are left behind in the database when the associated pattern recognition recipe was deleted.

- **ErrorMsg** — Allows you to view system error messages, modify error message characteristics (category, display, timeout, and logging), and to enter customer comments for error messages.

CAUTION

The *Meta*PULSE System error messages are preset by Rudolph Technologies. The error messages themselves cannot be modified. Only the "Customer Comment" that may be assigned to an error message should be entered or modified.

Security Administration

System security administration consists of enabling the security option in the system setup program, configuring user profiles for each person who will be performing tasks on the system, configuring user groups, and assigning individual users to the groups.

Security administration for the recipe database is the responsibility of the Owners of each recipe component. For detailed information on recipe security, refer to the *Meta*PULSE™ Applications Development Guide (Part Number A17994).

The *Meta*PULSE System provides three major categories of protection:

- Recipe Objects and Library Components protection
- Location or Program Mode protection
- System Program protection

Recipe and **Mode** protection covers all aspects of recipe creation, modification, deletion, and execution of executable objects (Cassette recipes) with embedded recipes and filmstacks. This protection also extends to Folders, Subfolders, Cassette recipes, library components (templates), and filmstacks.

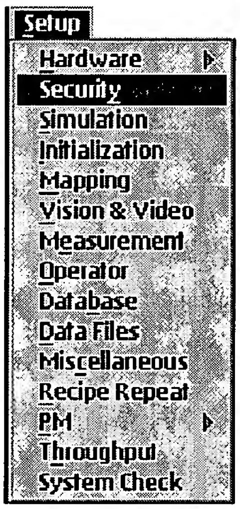
Certain operating modes are also protected (such as Recipe Creation Mode and Data Review Mode). Switching to a protected mode may require the operator to log in before access to the mode will be granted.

Program protection involves the protection of all system programs to prevent unauthorized use. Protected programs will require privileged users to login with passwords at all times. Recipe objects will always be protected in these programs. In addition, the protection of database objects designated as **Rudolph Standard** (default recipe objects as provided with the system by Rudolph Technologies) is strictly enforced.

System Security Configuration

This section provides information that will allow you to enable and configure the security options for your *Meta*PULSE System. System security options are configured through the use of the *Meta*PULSE **Setup** program.

1. Start the *Meta*PULSE Setup program using the instructions provided in Appendix A, "Starting the Setup Program".



2. With the Setup Main window displayed, select **Setup** from the Main menu then select **Security** when the Setup menu is displayed.

   The System Security Configuration window is displayed with the current system security setup as shown in Figure 2-2.

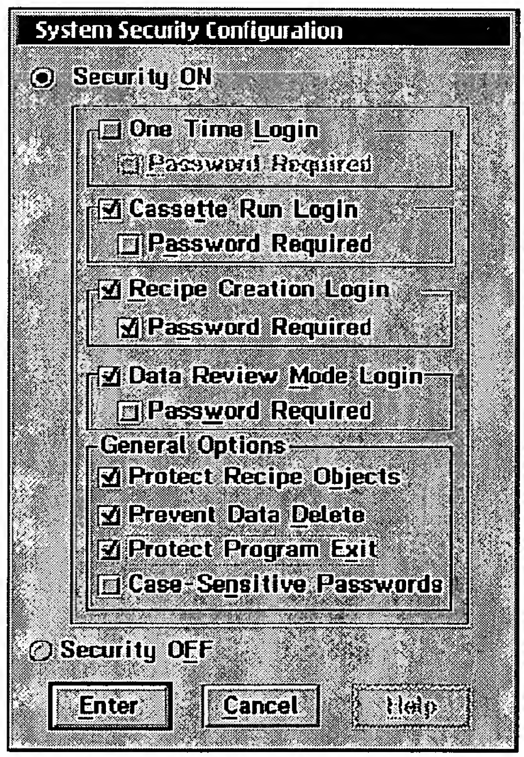


Figure 2-2. System Security Configuration Window

3. Perform **one** of the following:

   - **To disable system security:** Click on the **[Security OFF]** button then click on **[Enter]**.

   SECURITY NOTICE

   Turning off system security will allow any operator full access to the system, including (but not limited to) the ability to run any Cassette recipe, create and modify recipes, and access and delete measurement data. However, access to the Security Administration functions will still be controlled.

   - **To enable and configure system security:** Click on the **[Security ON]** button. Configure the system security options using the information provided in "Security Configuration — Login Options" on page AD 2–10. When the applicable security options have been configured, click on **[Enter]**.

   The System Security Configuration window closes and you are returned to the Setup Main window.

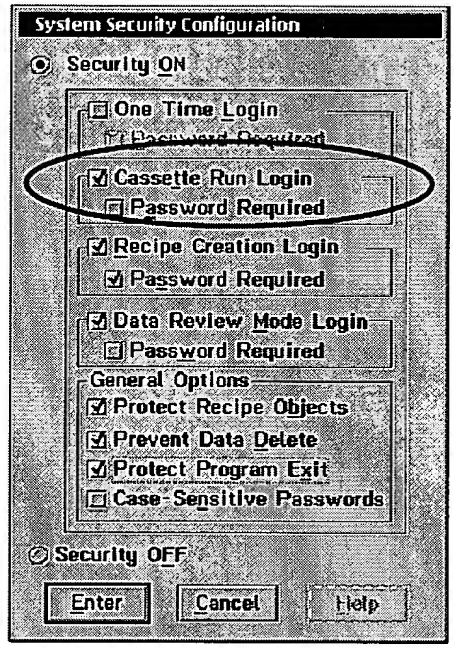
4. You may now perform other System setup tasks using the applicable section of this appendix, or exit Setup using the procedure in "Exiting the Setup Program" on page AD A–11.

5. If System security has been enabled, refer to "User and Group Security Configuration" on page AD 2–20 for information on how to set up and configure user logins and groups.

Security Configuration — Login Options

The following login options are available from the System Security Configuration window.

Cassette Run Login



When **Cassette Run Login** is not enabled, you will not be prompted to log in when you attempt to set up a Cassette recipe on a load port.

When **Cassette Run Login** is enabled, depending upon your current login status the system may prompt you to log in when you attempt to set up a Cassette recipe on a load port.

If you are not already logged in (User: Guest), or you are logged in but your login name does not have permission to run the selected Cassette recipe, you will be prompted to login.

If you are currently logged in with a login name that has permission to run the selected Cassette recipe, the system will not prompt you to login again and you will be permitted to set up the load port.

If the **Password Required** option is enabled, you must log in with a valid username/password combination when prompted. When **Password Required** is not enabled, only a valid username is required.

SECURITY NOTICE

The system logins (Admin, Default, and RTIEng) always require password entry.

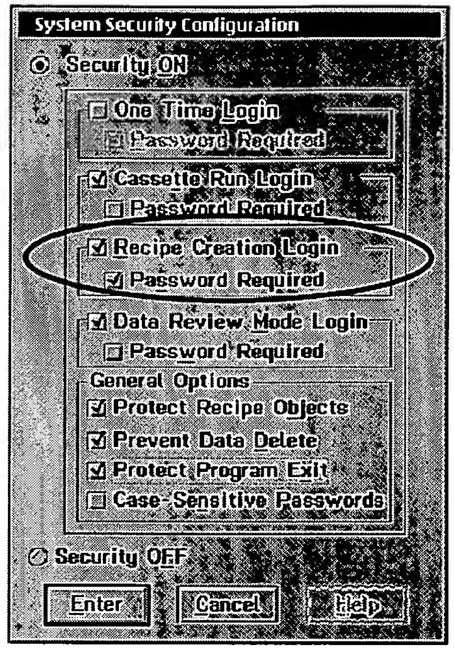
When "One Time Login" is enabled the system does not automatically log you out after performing a task. To maintain system security, it is important to remember to manually log out of the system when you have completed your tasks. Failure to do so may allow unauthorized users to have access to the recipe database, measurement data, and system security features.

Refer to Table 2-1 for a description of how **Cassette Run Login** interacts with other system security options.

Table 2-1. Cassette Run Login — Security Feature Interactions

Interaction with...	Description
One Time Login	If **One Time Login** is not enabled, you will be prompted to log in every time you attempt to set up a Cassette recipe on a load port (if you are not already logged in with a login name that has permission to run the selected Cassette recipe). Once the load port is set up, the system will automatically log you out (i.e. return you to the **Guest** login). If **One Time Login** is enabled, and you are not already logged in with a login name that has permission to run the selected Cassette recipe, you are prompted to log in the first time you set up a Cassette recipe on a load port. Once the load port is set up, the system will not automatically log you out. Each time you set up a load port thereafter, you will not be prompted to log in again unless you manually log out. After logging out, the next time you set up a load port, the system will prompt you to log in again. Refer to "One Time Login" on page AD 2–16 for more information.
Individual User Logins	Your login name must have adequate privilege levels to run the selected Cassette recipe. Refer to "User Administration" on page AD 2–29 for information on configuring a user record. Refer to the *Meta*PULSE™ Applications Development Guide (Part Number A17994) for information on setting security levels on Cassette recipes.

Recipe Creation Login



When **Recipe Creation Login** is not enabled, access to Recipe Creation Mode is not controlled. Any user account, including the **Guest** account, will be able to access Recipe Creation Mode.

When **Recipe Creation Login** is enabled, depending upon your current login status the system may prompt you to log in when you attempt to access Recipe Creation Mode.

If you are not already logged in (User: Guest), or you are logged in but your login name does not have permission to access Recipe Creation Mode, you will be prompted to login.

If you are currently logged in with a login name that has permission to access Recipe Creation Mode, the system will not prompt you to login again and you will be permitted to access Recipe Creation Mode.

If the **Password Required** option is enabled, you must log in with a valid username/password combination when prompted. When **Password Required** is not enabled, only a valid username is required.

SECURITY NOTICE

The system logins (Admin, Default, and RTIEng) always require password entry.

When "One Time Login" is enabled the system does not automatically log you out after performing a task. To maintain system security, it is important to remember to manually log out of the system when you have completed your tasks. Failure to do so may allow unauthorized users to have access to the recipe database, measurement data, and system security features.

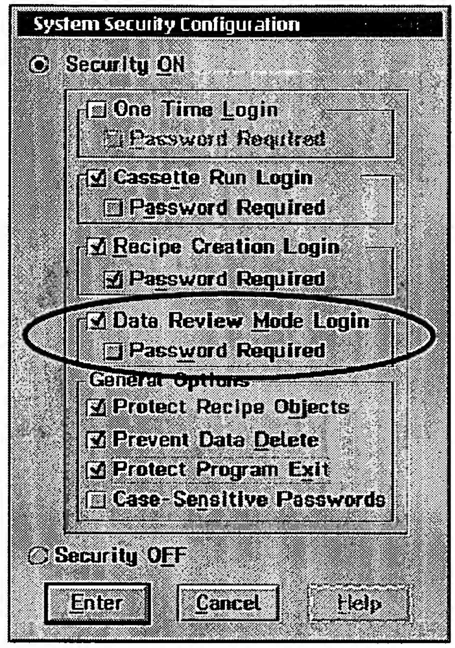
Protecting access to Recipe Creation Mode alone is not sufficient to ensure recipes are protected from unauthorized use. If Protect Recipe Objects is not also enabled, any operator may modify or delete any recipe database object except those designated as Rudolph Standard.

Refer to Table 2-2 for a description of how **Recipe Creation Login** interacts with other system security options.

Table 2-2. Recipe Creation Login — Security Feature Interactions

Interaction with...	Description
One Time Login	If **One Time Login** is not enabled, you will be prompted to log in every time you attempt to access Recipe Creation Mode (if you are not already logged in with a login name that has permission to access Recipe Creation Mode). You will remain logged in until you exit Recipe Creation Mode, at which time the system will automatically log you out (i.e. return you to the **Guest** login). If **One Time Login** is enabled, and you are not already logged in with a login name that has permission to access Recipe Creation Mode, you are prompted to log in the first time you attempt to access Recipe Creation Mode. Once you exit Recipe Creation Mode, the system will not automatically log you out. Each time you attempt to access a protected mode thereafter, you will not be prompted to log in again unless you manually log out or unless your login name does not have permission to access that mode. After logging out, the next time you attempt to access Recipe Creation Mode (or any other protected mode), the system will prompt you to log in again. Refer to "One Time Login" on page AD 2–16 for more information.
Individual User Logins	The login name used must have **Recipe Creation Mode** privileges or access to Recipe Creation Mode will be blocked. Refer to "User Administration" on page AD 2–29 for information.
Protect Recipe Objects (General Options Security Setting)	If the **Protect Recipe Objects** General Option is enabled and **Recipe Creation Login** is not enabled, you will be allowed to access Recipe Creation Mode and browse the recipe database without having to log in. However you will be prevented from modifying any item in the recipe database until you have logged in using a login name that has the necessary privilege levels to perform the desired task. Refer to "Protect Recipe Objects" on page AD 2–18 and "User Administration" on page AD 2–29 for information. Additional information on security for the recipe database is available in the *Meta*PULSE™ Applications Development Guide (Part Number A17994).

Data Review Mode Login



When **Data Review Mode Login** is not enabled, access to Data Review Mode is not controlled. Any user account, including the **Guest** account, will be able to access Data Review Mode.

When **Data Review Mode Login** is enabled, depending upon your current login status the system may prompt you to log in when you attempt to access Data Review Mode.

If you are not already logged in (User: Guest), or you are logged in but your login name does not have permission to access Data Review Mode, you will be prompted to login.

If you are currently logged in with a login name that has permission to access Data Review Mode, the system will not prompt you to login again and you will be permitted to access Data Review Mode.

If the **Password Required** option is enabled, you must log in with a valid username/password combination when prompted. When **Password Required** is not enabled, only a valid username is required.

SECURITY NOTICE

The system logins (Admin, Default, and RTIEng) always require password entry.

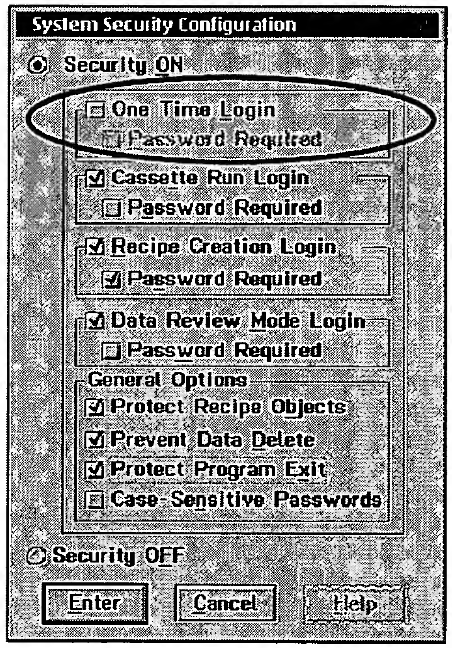
When "One Time Login" is enabled the system does not automatically log you out after performing a task. To maintain system security, it is important to remember to manually log out of the system when you have completed your tasks. Failure to do so may allow unauthorized users to have access to the recipe database, measurement data, and system security features.

Refer to Table 2-3 for a description of how **Data Review Mode Login** interacts with other system security options.

Table 2-3. Data Review Mode Login — Security Feature Interactions

Interaction with...	Description
One Time Login	If **One Time Login** is not enabled, you will be prompted to log in every time you attempt to access Data Review Mode (if you are not already logged in with a login name that has permission to access Data Review Mode). You will remain logged in until you exit Data Review Mode, at which time the system will automatically log you out (i.e. return you to the **Guest** login). If **One Time Login** is enabled, and you are not already logged in with a login name that has permission to access Data Review Mode, you are prompted to log in the first time you attempt to access Data Review Mode. Once you exit Data Review Mode, the system will not automatically log you out. Each time you attempt to access a protected mode thereafter, you will not be prompted to log in again unless you manually log out or unless your login name does not have permission to access that mode. After logging out, the next time you attempt to access Data Review Mode (or any other protected mode), the system will prompt you to log in again. Refer to "One Time Login" on page AD 2–16 for more information.
Individual User Logins	The login name used must have **Data Review Mode** privileges or access to Data Review Mode will be blocked. Refer to "User Administration" on page AD 2–29 for information.

One Time Login



When **One Time Login** is not enabled, the system will prompt you to log in each time an attempt is made to access a protected mode.

If **One Time Login** is enabled, you will be prompted to log in only the first time an attempt is made to access a protected mode. Once logged in, you will remain logged in and will not be prompted to log in again unless you manually log out.

One Time Login does not override the privileges assigned to a login name. If you have permission to access only Data Review Mode, any attempt to enter Recipe Creation Mode will be blocked even if you are already logged in and **One Time Login** is enabled.

If the **Password Required** option is enabled, you must log in with a valid username/password combination when prompted. When **Password Required** is not enabled, only a valid username is required.

SECURITY NOTICE

The system logins (Admin, Default, and RTIEng) always require password entry.

When "One Time Login" is enabled the system does not automatically log you out after performing a task. To maintain system security, it is important to remember to manually log out of the system when you have completed your tasks. Failure to do so may allow unauthorized users to have access to the recipe database, measurement data, and system security features.

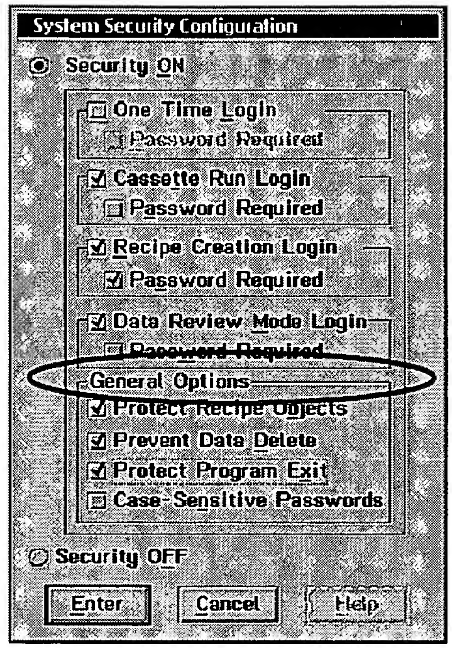
Refer to Table 2-4 for a description of how **One Time Login** interacts with other system security options.

Table 2-4. One Time Login — Security Feature Interactions

Interaction with...	Description
Cassette Run Login	If **One Time Login** and **Cassette Run Login** are both enabled, you are prompted to log in the first time you set up a Cassette recipe on a load port. Each time you set up a load port thereafter, or access any other protected mode for which you have permission levels, you will not be prompted to log in again until after you specifically log out. After logging out, the next time you set up a load port, the system will prompt you to log in again. If **One Time Login** is not enabled, you will be prompted to log in every time you attempt to set up a Cassette recipe on a load port. Refer to "Cassette Run Login" on page AD 2–10 for more information.
Recipe Creation Login	If **One Time Login** and **Recipe Creation Login** are both enabled, you are prompted to login the first time you access Recipe Creation Mode. Each time you access Recipe Creation Mode thereafter, or access any other protected mode for which you have permission levels, you will not be prompted to login again until after you specifically log out. After logging out, the next time you access Recipe Creation Mode, the system will prompt you to log in again. If **One Time Login** is not enabled, you will be prompted to log in every time you attempt to access Recipe Creation Mode. Refer to "Recipe Creation Login" on page AD 2–12 for more information.
Data Review Login	If **One Time Login** and **Data Review Login** are both enabled, you are prompted to login the first time you access Data Review Mode. Each time you access Data Review Mode thereafter, or access any other protected mode for which you have permission levels, you will not be prompted to login again until you specifically log out. After logging out, the next time you access Data Review Mode, the system will prompt you to log in again. If **One Time Login** is not enabled, you will be prompted to log in every time you attempt to access Data Review Mode. Refer to "Data Review Mode Login" on page AD 2–14 for more information.
Individual User Logins	The login name used must have the appropriate privileges or access to the selected mode will be blocked regardless of the **One Time Login** setting. If **One Time Login** is enabled and you successfully login and access a protected mode, any attempt to enter a mode that your login does not have permission to access will be blocked. Refer to "User Administration" on page AD 2–29 for more information.

Security Configuration — General Options

You may further refine your system security by using the security settings available under the **General Options** heading of the System Security Configuration window.



The use of these security settings, when used in conjunction with the Login Options, provides for the security of protected objects in the recipe and measurement databases.

The sections that follow describe the general options available from the System Security Configuration window.

Protect Recipe Objects

When **Protect Recipe Objects** is enabled, recipe security is enforced on all protected recipes and library resources. Only those recipe objects for which your login has **Write** permission can be modified or deleted.

SECURITY NOTICE

If Protect Recipe Objects is not enabled, any operator may modify or delete any recipe database object except those designated as Rudolph Standard. Protecting access to Recipe Creation Mode only is not sufficient to ensure recipes are protected from unauthorized use.

Table 2-5. Protect Recipe Objects — Security Feature Interactions

Interaction with...	Description
Recipe Creation Login	If **Protect Recipe Objects** is enabled and **Recipe Creation Login** is not enabled, you will be allowed to access Recipe Creation Mode and browse the recipe database without having to log in. However you will be prevented from creating, modifying, or deleting any item in the recipe database unless you do log in and your login has the necessary privilege levels to perform the desired task. Refer to "Recipe Creation Login" on page AD 2–12 and "User Administration" on page AD 2–29.
Individual User Logins	The login name used must have **Write** privileges in order to perform the desired task. Refer to "User Administration" on page AD 2–29.

Prevent Data Delete

When **Prevent Data Delete** is enabled, measurement data is protected from deletion in Data Review Mode. Only a privileged user or the Owner of the Cassette recipe used to generate the data will be permitted to delete any related measurement data within the selected Cassette recipe. The Data Write (**DW**) attribute must be enabled on the cassette in order to be able to delete data.

SECURITY NOTICE

If Prevent Data Delete is not enabled, any operator may delete measurement data. Protecting access to Data Review Mode only is not sufficient to ensure measurement data is protected from unauthorized deletion.

Protect Program Exit

When **Protect Program Exit** is enabled, only authorized users are permitted to exit the Operator program.

Table 2-6. Protect Program Exit — Security Feature Interactions

Interaction with...	Description
Individual User Logins	The login name used must have **Shutdown Running Program** privileges or exiting the program will be blocked. Refer to "User Administration" on page AD 2–29 for information.

Case-Sensitive Passwords

When the **Case-Sensitive Passwords** option is enabled, you must enter a case-sensitive password any time password entry is required.

User and Group Security Configuration

This section provides information that will allow you to access the *Meta*PULSE security administration screens in order to configure user and group security. User and Group security options are configured through the use of the *Meta*PULSE **Operator** program.

SECURITY NOTICE

The "Login", "Logout", "Change Password", and "Security Admin" items in the System menu are only available if security was enabled in the Setup program. Refer to "System Security Configuration" on page AD 2–8 for information.

You must be a member of the Administrators group in order to access the Security Administration features.

Operator

1. Start the *Meta*PULSE Operator program by double clicking on the **Operator** icon in the RTI Applications folder on the OS/2 desktop.

   The Cassette Run View is displayed as shown in Figure 2-3.

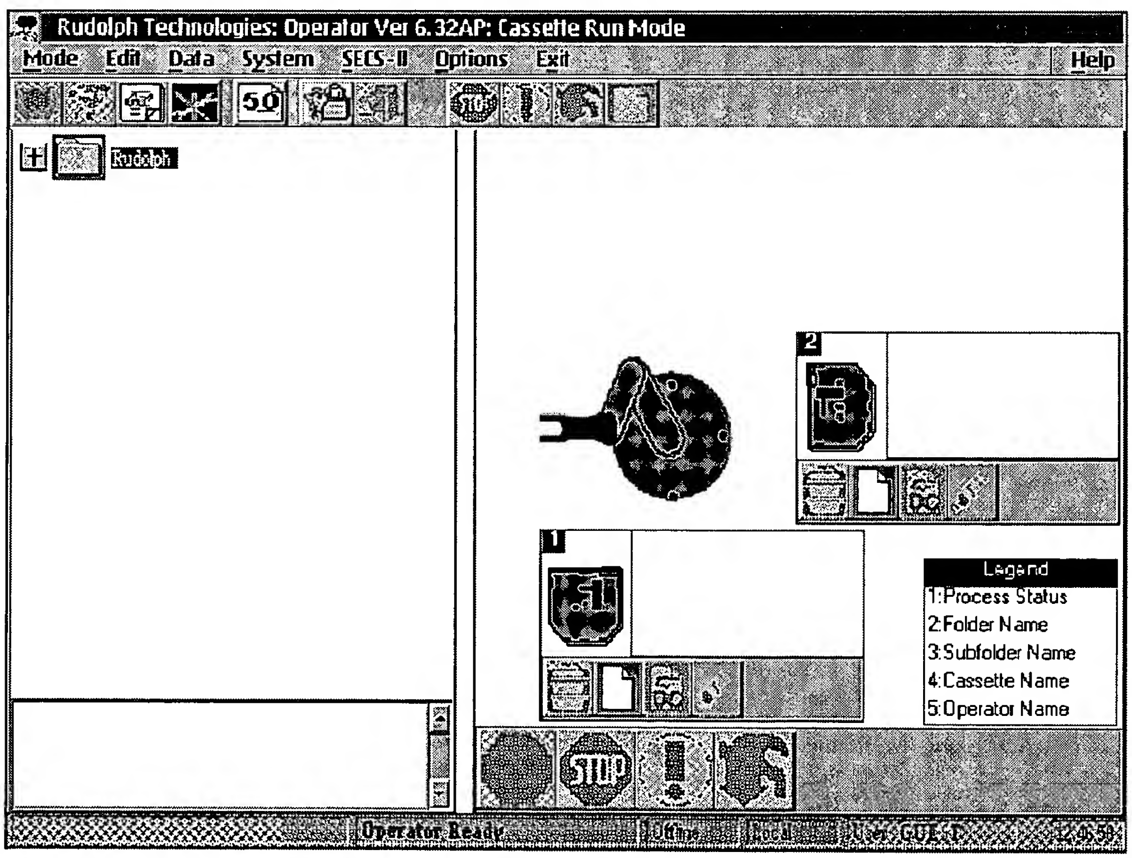
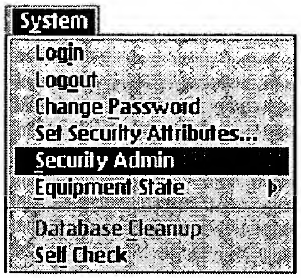


Figure 2-3. Operator Program — Cassette Run View (*Meta*PULSE 200 System)



1. Select **System** from the Cassette Run View Main menu, then select **Security Admin** when the System menu is displayed.

   One of the following will occur:

   - **If you are not currently logged in (User: GUEST) or you are logged in but do not have Administrator privileges:** The User Login window is displayed as shown in Figure A-9 on page AD A-15. Log in using the procedure provided in "Logging In to the Operator Program" on page AD A–14.

NOTE

The login name selected must have administrative privileges or an error message is displayed.

Once you have successfully logged in, the Security Administration window is displayed as shown in Figure 2-4.

   - **If you are already logged in and your login has Administrator privileges:** The Security Administration window is displayed as shown in Figure 2-4.

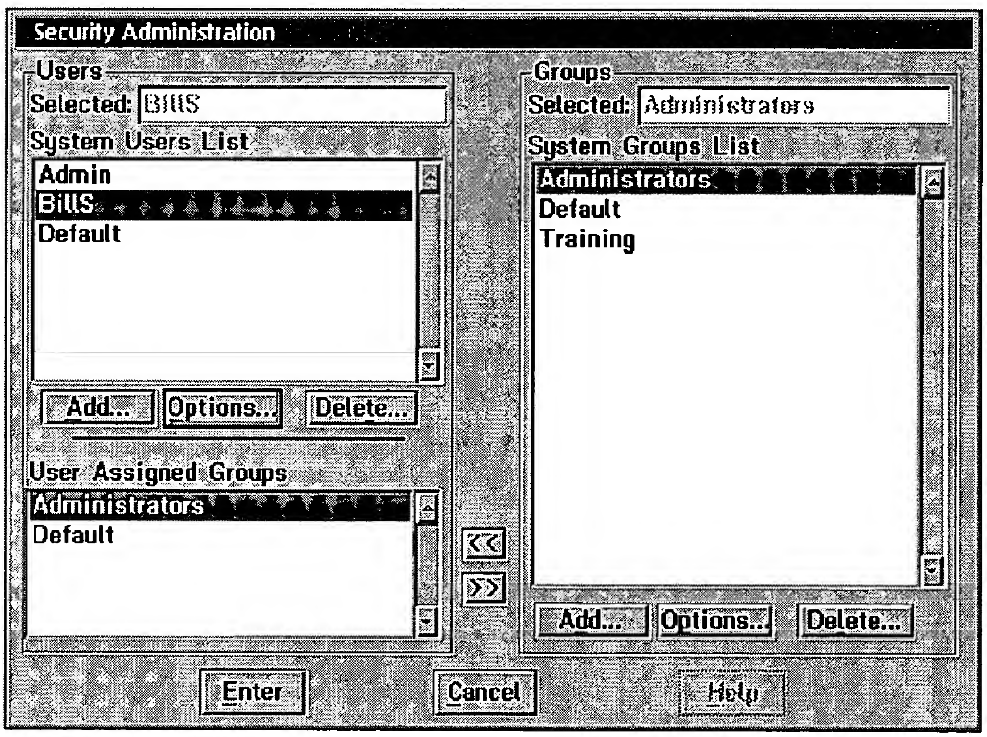


Figure 2-4. Security Administration Window

2. Perform any of the following:

   - **To add new groups:** refer to "Adding Groups" on page AD 2–23.
   - **To modify existing groups:** refer to "Changing Group Properties" on page AD 2–26.
   - **To delete groups:** refer to "Deleting Groups" on page AD 2–27.
   - **To add new users:** refer to "Adding Users" on page AD 2–29.
   - **To modify existing users:** refer to "Changing User Properties" on page AD 2–34.
   - **To delete users:** refer to "Deleting Users" on page AD 2–35.
   - **To assign users to groups:** refer to "Assigning Users to Groups" on page AD 2–36.
   - **To rename users and/or groups:** refer to "Renaming Users and Groups" on page AD 2–38.

3. When all of the configuration tasks have been completed, click on **[Enter]** in the Security Administration window.

   The changes are saved in the database.

NOTE

None of the changes made to the system users are saved in the database until the [Enter] button on the Security Administration window is pressed. Pressing the [Cancel] button will undo all of the changes that were made. Changes made to the system groups take effect immediately.

Group Administration

Groups are logical groupings of one or more system users.

When configuring groups, the administrator has the ability to create groups and assign default access control levels, modify the access control levels of existing groups, and delete groups.

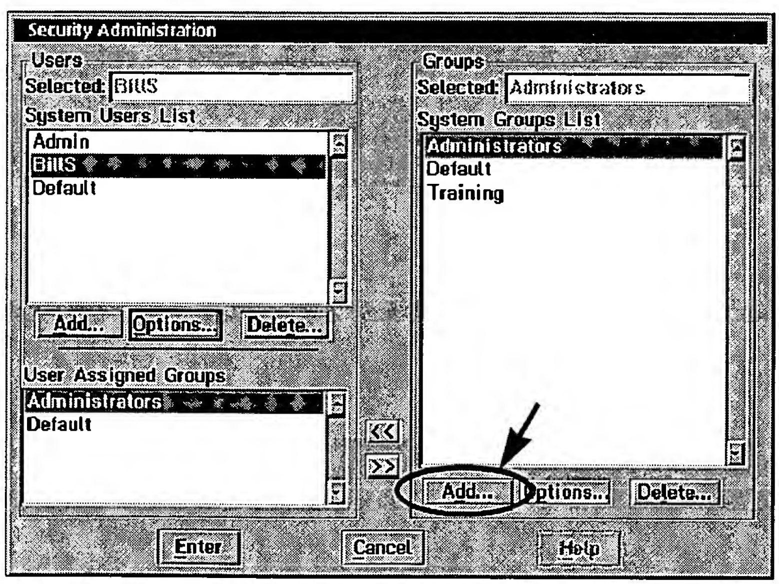
The *Meta*PULSE System comes configured with three default groups as described in Table 2-7.

Table 2-7. Default User Groups

Group Name	Description
Default	The default user group. All users are automatically assigned to this group when their user record is created. This group can be modified but cannot be deleted.
Administrators	Users who will have system administrative privileges are included in this group. This group cannot be modified or deleted.
RTIEngineers	Reserved for Rudolph Technologies Engineers. This group is only displayed if you are logged into the system as **RTIEng** or your login is a member of the RTIEngineers group. This group cannot be modified or deleted.

Adding Groups

To add new groups to the system, perform the following:



1. With the Security Administration window displayed, click on the **[Add]** button under the **System Groups List** box.

   The Add New Group window is displayed as show in Figure 2-5.

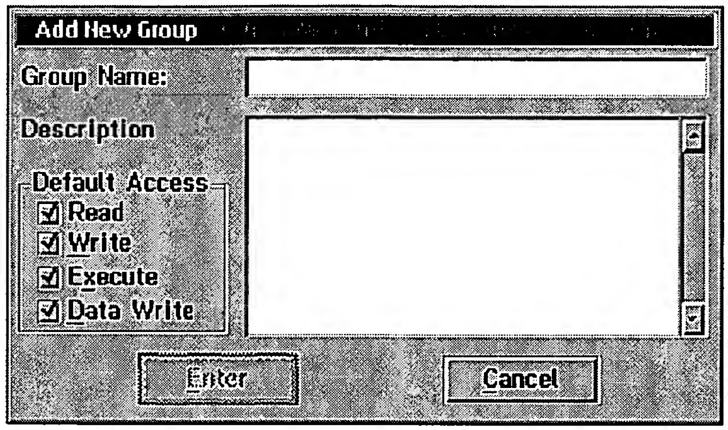


Figure 2-5. Add New Group Window

2. Enter a name for the new group in the **Group Name** field.
3. Enter a description for the group in the **Description** field if desired.
4. Set the default access control setting assignments for the group by clicking on the **[Read]**, **[Write]**, **[Execute]**, and **[Data Write]** buttons as desired.

SECURITY NOTICE

The access control settings applied to the groups are default values only. These settings may be modified within an individual login record, or within the security profile of an individual Folder, Subfolder, or Cassette recipe.

NOTE

For each of the access control buttons, a checkmark in the button indicates the access level is granted, no checkmark indicates the access level is denied. Clicking on the button will toggle the access level on and off.

Table 2-8 provides definitions of the Access Control settings.

Table 2-8. Group Access Control Settings

Access Control	Definition
Read	When selected, members of this group are granted permission to read Folders, Subfolders, or Cassette recipes.
Write	When selected, members of this group are granted permission to create, modify or delete Folders, Subfolders, or Cassette recipes. **Notes:** If an individual user record does not have **Create Recipe Items** privilege, the user will be prevented from creating new items regardless of the **Write** setting. If an individual user record has the **Global Delete Option** set to **Cannot Delete Any Recipe Item**, the user will be prevented from deleting items regardless of the **Write** setting. If an individual user record has the **Global Delete Option** set to **Can Only Delete User's Own Recipe Items**, the user will be prevented from deleting items which are not specifically owned by the user regardless of the **Write** setting. For information on configuring user records, refer to "User Administration" on page AD 2–29.
Execute	When selected, members of this group are granted permission to execute items. **Note:** Only Cassette recipes may be executed.
Data Write	When selected, members of this group are granted permission to edit measurement data in Data Review Mode.

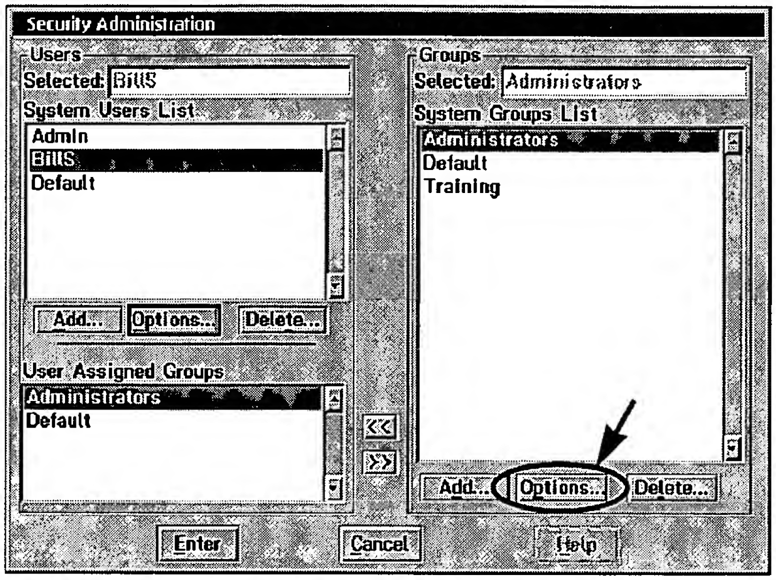
5. When you have completed all information in the window, click on the **[Enter]** button.

   You are returned to the Security Administration window. The newly entered group name is now displayed in the **Selected** field as well as in the **System Groups List** box.

6. Return to Step 2 on page AD 2–22 to continue user and group security administration.

Changing Group Properties

To modify an existing group's properties, perform the following:



1. With the Security Administration window displayed, select the group you wish to modify then click on the **[Options]** button under the **System Groups List** box.

SECURITY NOTICE

The "Administrators" and "RTIEngineers" groups cannot be modified.

The "RTIEngineers" group is only displayed if you logged in as "RTIEng".

The Update Group window is displayed with the current security settings for the selected group as shown in Figure 2-6.

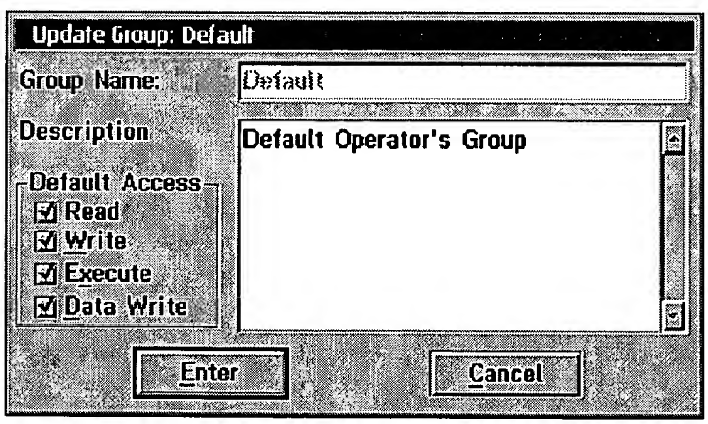


Figure 2-6. Update Group Window

2. Update the group properties as desired using the information provided in "Adding Groups" on page AD 2–23.

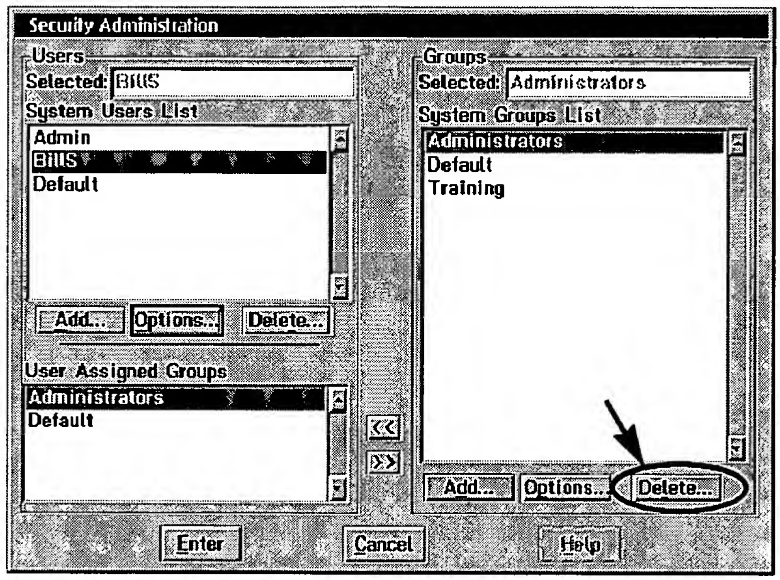
3. When you have completed all information in the window, click on **[Enter]**.

   You are returned to the Security Administration window.

4. Return to Step 2 on page AD 2–22 to continue user and group security administration.

Deleting Groups

To delete an existing group, perform the following:



1. With the Security Administration window displayed, select the group you wish to delete then click on the **[Delete]** button under the **System Groups List** box.

   A Delete Group message is displayed asking you to verify that you wish to delete the selected group.

SECURITY NOTICE

The system groups ("Administrators", "Default", and "RTIEngineers") cannot be deleted.

The "RTIEngineers" group is only displayed if you logged in as "RTIEng".

2. Perform **one** of the following:

   - **To delete the selected group:** click on **[Yes]**.

     ### SECURITY NOTICE

     If any items are linked to the group you are attempting to delete, a message will be displayed informing you of the links and asking you to verify that you wish to delete the group anyway. Click on [Yes] to delete the group, click on [No] to retain the group.

     The group is deleted and you are returned to the Security Administration window. The group is removed from the **System Groups List**.

   - **To keep the group:** click on **[No]**.

     The group is not deleted and you are returned to the Security Administration window.

3. Return to Step 2 on page AD 2–22 to continue user and group security administration.

User Administration

Users are the individuals who log into the system to perform tasks, such as running measurement processes and creating wafer recipes. Each user may be assigned to one or more user groups.

For information on administering user groups, refer to "Group Administration" on page AD 2–23.

When configuring user records, the administrator has the ability to create new users and set the privileges (properties) for the user, modify the properties of existing users, and assign users to groups.

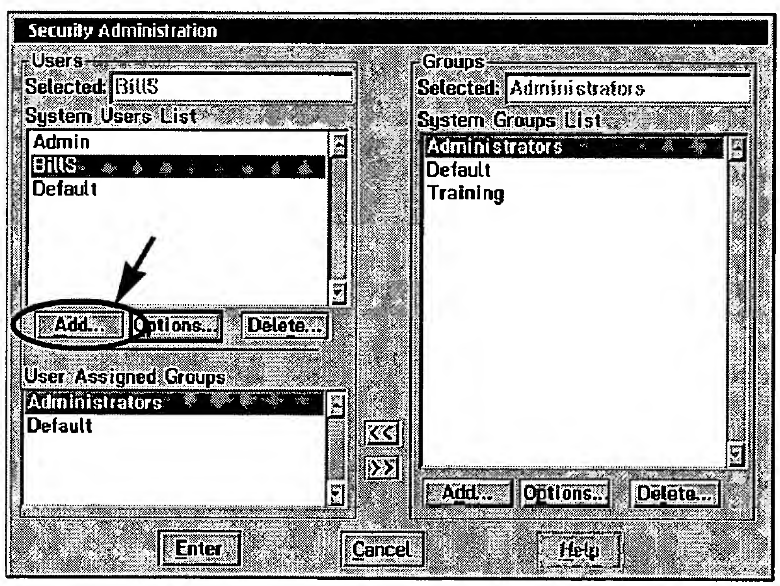
The *Meta*PULSE System comes configured with default users as described in Table 2-9.

Table 2-9. Default System Users

User Name	Description
Default	The Default user has minimal privileges. This user record can be modified but cannot be deleted.
Admin	The system administrator. This user record cannot be deleted and only the password can be modified.
RTIEng	Reserved for Rudolph Technologies Engineers. This user record cannot be modified or deleted.

Adding Users

To add new users to the system, perform the following:



1. With the Security Administration window displayed, click on the **[Add]** button under the **System Users List** box.

   The Add New User window is displayed as show in Figure 2-7.

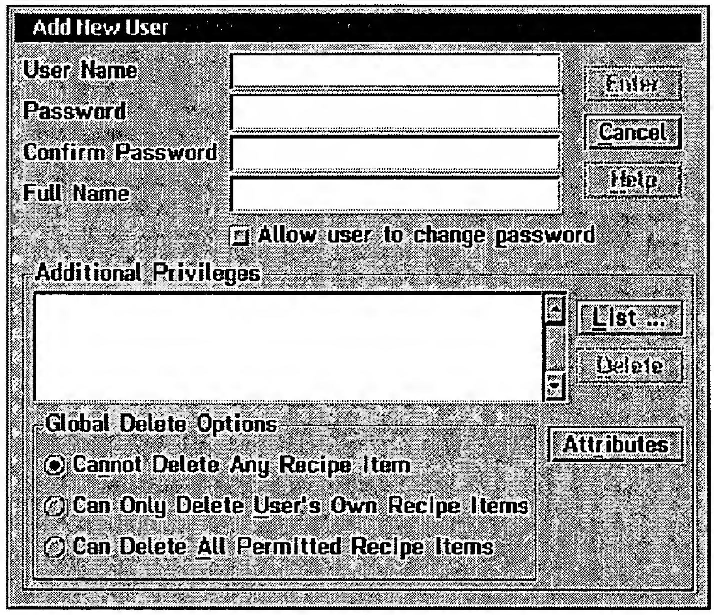


Figure 2-7. Add New User Window

2. Enter a login name for the new user in the **User Name** field.

3. Enter a password for the user in the **Password** field.

SECURITY NOTICE

Passwords may or may not be case sensitive depending upon your system configuration. Refer to "System Security Configuration" on page AD 2–8.

4. Re-enter the same password in the **Confirm Password** field.

5. Enter the user's name in the **Full Name** field.

6. Perform **one** of the following:

   - **If this user will be allowed to change the login password:** click on the **[Allow user to change password]** button so a checkmark appears (if necessary). The checkmark indicates the permission is granted. Clicking on the button toggles permission on and off.

   - **If this user will not be allowed to change the login password:** click on the **[Allow user to change password]** button so no checkmark appears (if necessary). No checkmark indicates the permission is denied. Clicking on the button toggles permission on and off.

7. Perform **one** of the following:

   - **If the privileges shown in the "Additional Privileges" box are satisfactory:** go to Step 8.

   - **To delete a privilege from the list:** select the privilege from the list then click on the **[Delete]** button. Repeat this step as necessary to delete additional privileges.

     The selected privilege is removed from the list.

   - **To add a privilege to the list:** click on the **[List]** button to display the Additional Privileges List window (as shown in Figure 2-8). Using the information provided in Table 2-10, highlight the privilege you wish to add and click on **[Enter]**. Repeat this step as necessary to add additional privileges.

     The selected privilege is added to the list.

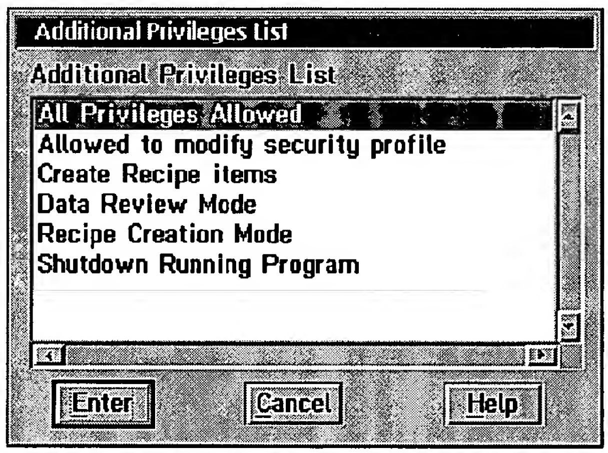


Figure 2-8. Additional Privileges List Window

Table 2-10. Additional Privilege Settings

Privilege	Definition
All Privileges Allowed	Allows this user to create recipe database objects, enter Data Review Mode and Recipe Creation Mode, and shutdown the Operator program. Selecting this option is the equivalent of selecting all of the individual privileges.
Allowed to Modify Security Profile	Allows this user to modify the security properties for their login, but not to create recipe database objects, enter Data Review Mode or Recipe Creation Mode, or to shutdown the Operator program. May be combined with any of the other individual privileges.
Create Recipe Items	Allows this user to create recipe database objects, but not to enter Data Review Mode or Recipe Creation Mode, or to shutdown the Operator program. May be combined with any of the other individual privileges.
Data Review Mode	Allows this user to enter Data Review Mode, but not to create recipe database objects, enter Recipe Creation Mode, or shutdown the Operator program. May be combined with any of the other individual privileges.
Recipe Creation Mode	Allows this user to enter Recipe Creation Mode, but not to create recipe database objects, enter Data Review Mode, or shutdown the Operator program. May be combined with any of the other individual privileges.
Shutdown Running Program	Allows this user to shutdown the Operator program, but not to create recipe database objects or enter Data Review Mode or Recipe Creation Mode. May be combined with any of the other individual privileges.

8. Set the delete permission level for this user. Click on the button beside one of the following options:

Table 2-11. Global Delete Options

Option	Definition
Cannot Delete Any Recipe Item	User is not allowed to delete any Folder, Subfolder, or Cassette recipe (even items this user owns) regardless of the permission level assigned by the Owner.
Can Only Delete User's Own Recipe Items	May only delete Folders, Subfolders, or Cassette recipes owned by this user regardless of the permission level assigned to other items.
Can Delete All Permitted Recipe Items	Allowed to delete any Folder, Subfolder, or Cassette recipe for which the user has **Write** permission. The user must either own the item, belong to one or more of the groups allowed to modify the item, or the item must have the Public Write access enabled.

9. Set the default security attributes for this user. Click on the **[Attributes]** button.

   The Set/Change Security Properties window is displayed with the current security property configuration as shown in Figure 2-9.

   The settings in this window will be applied as the default group assignments and access control settings for any item this user creates in the recipe database. The user may then make modifications to the settings as necessary.

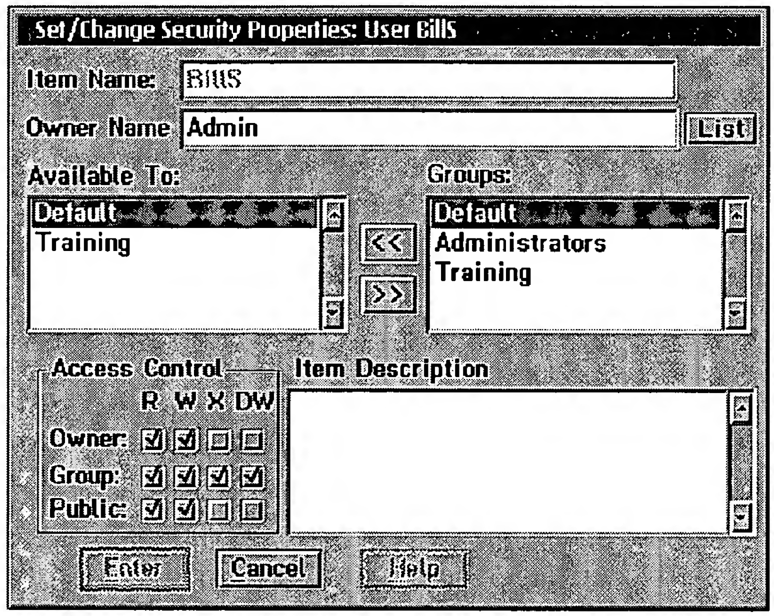


Figure 2-9. Set/Change Security Properties Window

10. Set the group assignments and access control settings as desired. When changes are complete, click on the **[Enter]** button.

    You are returned to the Add New User window.

11. When you have completed all information in the window, click on **[Enter]**.

    The Add New User window closes and you are returned to the Security Administration window. The newly entered user name is now displayed in the **Selected** field and the **System Users List**.

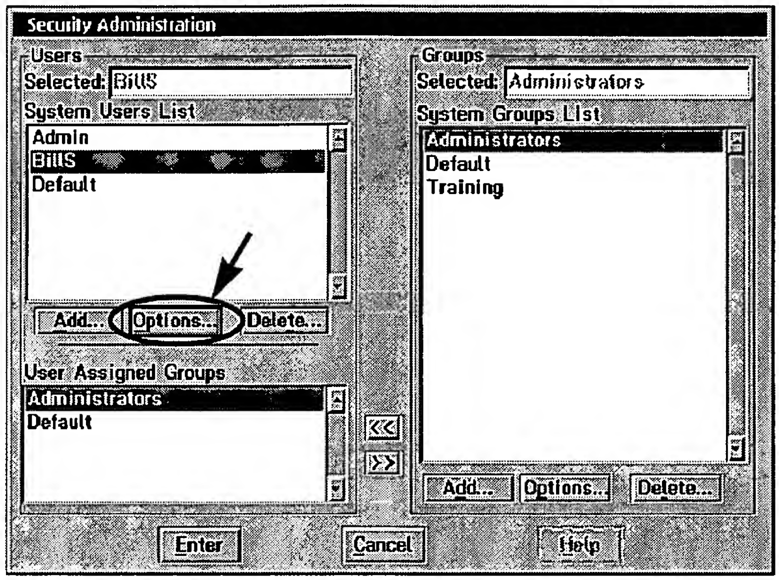
NOTE

The user is also automatically assigned to the "Default" system group.

12. Return to Step 2 on page AD 2–22 to continue security administration.

Changing User Properties

To modify an existing users properties, perform the following:



1. With the Security Administration window displayed, select the user you wish to modify then click on the **[Options]** button under the **System Users List** box.

   The Update User Properties window is displayed with the current security settings for the selected user as shown in Figure 2-10.

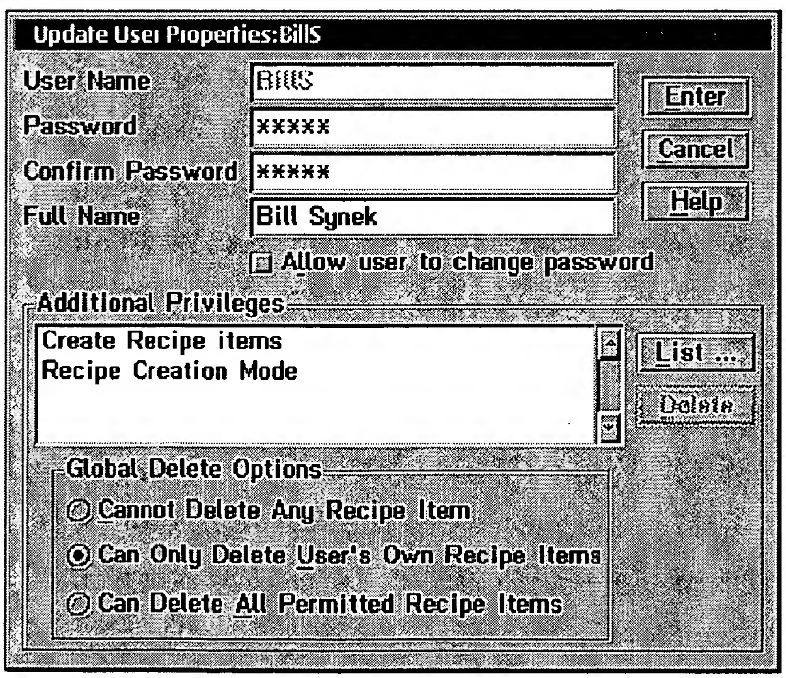


Figure 2-10. Update User Properties Window

SECURITY NOTICE

The "User Name" field cannot be modified.

2. Update the user properties as desired using the information provided in "Adding Users" on page AD 2–29.

SECURITY NOTICE

The user properties for the RTIEng user cannot be modified.

Passwords may or may not be case sensitive depending upon your system configuration. Refer to "System Security Configuration" on page AD 2–8.

If you change "Password" field, you must enter the same password in the "Confirm Password" field.

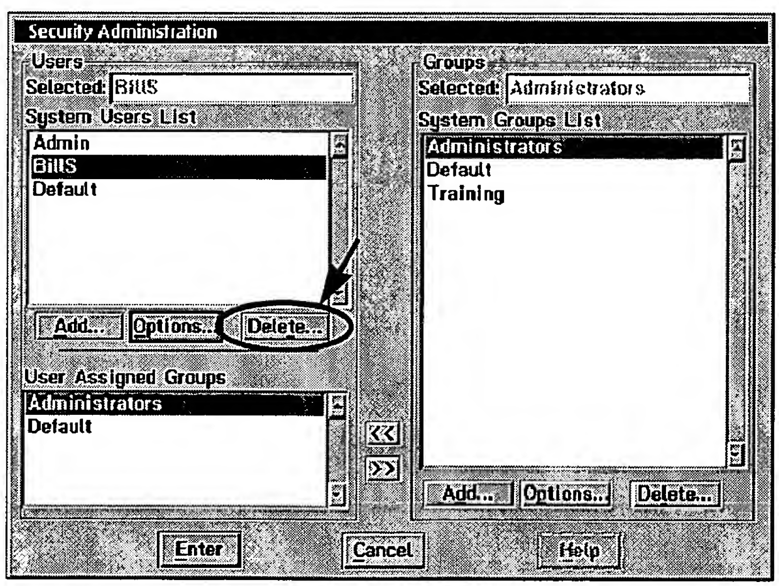
3. When you have completed all information in the window, click on **[Enter]**.

   You are returned to the Security Administration window.

4. Return to Step 2 on page AD 2–22 to continue user and group security administration.

Deleting Users

To delete an existing user, perform the following:



1. With the Security Administration window displayed, select the user you wish to delete then click on the **[Delete]** button under the **System Users List** box.

   A message is displayed asking you to verify that you wish to delete the selected user.

   SECURITY NOTICE

   The Admin, Default, and RTIEng users cannot be deleted. An error message will be displayed if you attempt to delete one of the system default users.

2. Perform **one** of the following:

   - **To delete the selected user:** click on **[Yes]**.

     The user is deleted and you are returned to the Security Administration window. The user is removed from the **System Users List**.

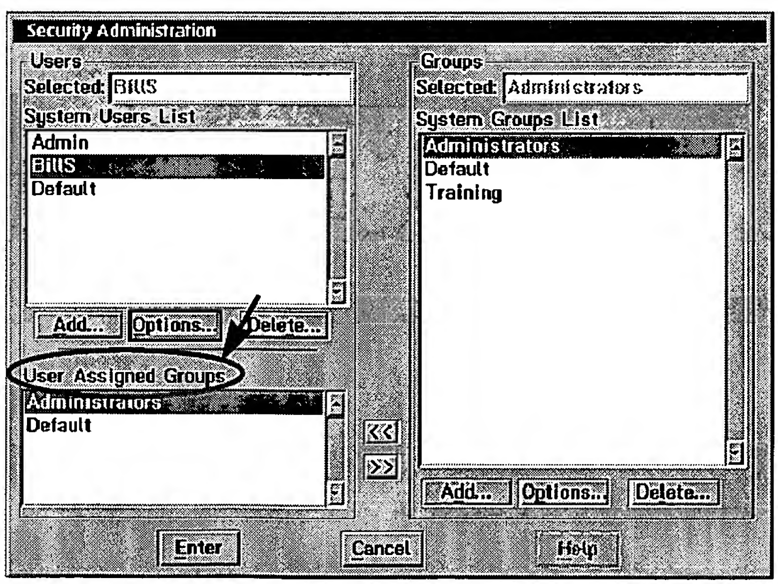
   - **To keep the user:** click on **[No]**.

     The user is not deleted and you are returned to the Security Administration window.

3. Return to Step 2 on page AD 2–22 to continue security administration.

Assigning Users to Groups

To make group assignments for users, perform the following:



1. With the Security Administration window displayed, select a user name from the **System Users List** box.

   The selected user name is highlighted and the currently assigned groups are displayed in the **User Assigned Groups** box.

2. Perform any of the following:

   - **To add the user to a group:** select the appropriate group you want to add to the **User Assigned Groups** list by either double clicking on the group name in the **System Groups List** box, or by clicking on the group name and then clicking on the left arrow button. 

     The selected group name is displayed in the **User Assigned Groups** box.

     SECURITY NOTICE

     All users are automatically assigned to the "Default" system group when the user record is created.

   - **To delete the user from a group:** select the appropriate group you want to remove from the **User Assigned Groups** list by either double clicking on the group in the **User Assigned Groups** box, or by clicking on the group name and then clicking on the right arrow button. 

     The selected group name is removed from the **User Assigned Groups** box.

     SECURITY NOTICE

     The system automatically assigns the "Admin" user to the Default and Administrators groups, the "Default" user to the Default group, and the "RTIEng" user to the Administrators, Default, and RTIEngineers groups.

     Admin, Default, and RTIEng users cannot be deleted from their default groups. However, they may be added to and/or removed from additional group assignments.

     If a user is removed from all assigned groups, that user may only access protected objects owned by that user or objects for which the proper Public access privileges have been set.

3. Return to Step 2 on page AD 2–22 to continue security administration.

Renaming Users and Groups

User login names and group names may be changed after they have been added to the system. Refer to "User Administration" on page AD 2–29 and "Group Administration" on page AD 2–23 for information on adding and configuring users and groups.

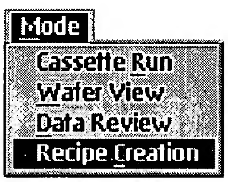
SECURITY NOTICE

You must have Administrator privileges in order to rename users and groups.

System default users (Admin, Default, Guest, and RTIEng), and system default groups (Administrators, Default, and RTIEngineers), cannot be renamed.

Perform the following to rename users or groups:

Recipe Creation Mode



1. With the Operator program running (refer to "Starting the Operator Program" on page AD A–12), change to Recipe Creation Mode by either clicking on the **[Recipe Creation Mode]** button in the tool bar, or selecting **Mode** from the Main Menu, then **Recipe Creation** when the Mode menu is displayed.

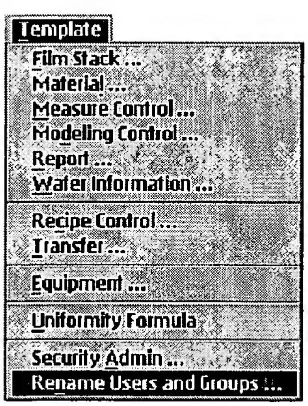
SECURITY NOTICE

Depending upon system configuration, you may be prompted to log in before you may access Recipe Creation Mode.

- **If prompted to log in:** log in by selecting the applicable login name and entering a password (if required).

  Upon successful login, the Operator program changes to Recipe Creation Mode.

- **If not prompted to log in:** the Operator program changes to Recipe Creation Mode.



2. Select **Template** from the Recipe Creation Mode Main Menu. Select **Rename Users and Groups** when the Template menu is displayed.

- **If prompted to log in:** log in by selecting the applicable login name and entering a password. The selected login must have administrator privileges.

  Upon successful login, the Rename System Users and Groups window is displayed with the list of users and groups that may be renamed, as shown in Figure 2-11.

- **If not prompted to log in:** the Rename System Users and Groups window is displayed with the list of users and groups that may be renamed, as shown in Figure 2-11.

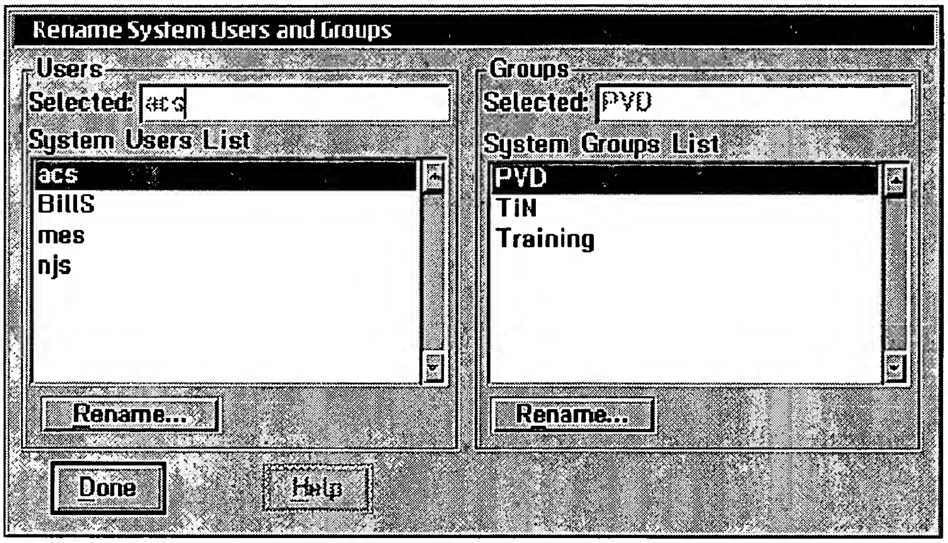


Figure 2-11. Rename System Users and Groups Window

3. Perform one of the following:

   - **To rename a System User:** select the User to be renamed from the System Users List then click on the **[Rename]** button under the System Users List, or double click on the applicable user name.

   - **To rename a System Group:** select the Group to be renamed from the System Groups List then click on the **[Rename]** button under the System Groups List, or double click on the applicable group name.

   A Rename User or Rename Group window is displayed as shown in Figure 2-12. The name that was selected will appear in the **Old Name field**.

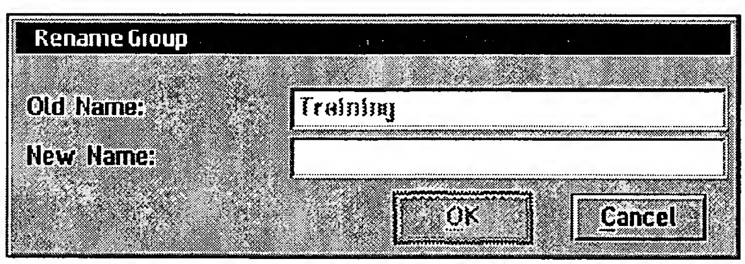


Figure 2-12. Rename User/Group Window

NOTE

The new name will take effect, and the database will be updated, immediately upon clicking [OK] in the next step.

4. Enter the new name for the User or Group in the **New Name** field, then click on **[OK]**.

   You are returned to the Rename System Users and Groups window. The new name appears in the appropriate list box and the system database is updated.

5. Perform **one** of the following:

   - **To rename another user or group:** repeat Step 3 and Step 4 above for each user and/or group you wish to rename.

   - **When you have completed renaming users and groups:** click on **[Done]** in the Rename System Users and Groups window.

     You are returned to the Recipe Creation Mode main window.

Cassette Run Mode

6. Change to Cassette Run Mode by either clicking on the **[Cassette Run Mode]** button in the tool bar, or selecting **Mode** from the Main Menu, then **Cassette Run** when the Mode menu is displayed.

7. Return to Step 2 on page AD 2–22 to continue security administration.

Hardware and Software Configuration

The *Meta*PULSE System hardware and software is configured by Rudolph Technologies personnel at the time of system installation. These settings should not be modified except as directed by Rudolph Technologies.

If you believe that the system configuration needs to be modified through the **Setup** program, contact Rudolph Technologies support personnel for assistance.

CAUTION

Modifying the *Meta*PULSE System setup may cause the system to function incorrectly or to not function at all. Contact Rudolph Technologies support personnel before making any changes to the system setup.

The following sections provide basic information required for configuring the following SECS-II related items:

- SMIF system operation
- Tag Reader
- Cassette mapping
- Process Start options

Additional information is provided in the VANGUARD™ SECS-II/GEM Interface Specifications (Part Number A17792).

SMIF Configuration

SMIF System operation is configured through the **Setup** program.

1. Start the Setup program using the instructions provided in "Starting the Setup Program" on page AD A–10.

2. Select **Setup** from the Main menu, then select **Hardware** from the Setup menu. Select **SMIF** when the Hardware menu is displayed.

   The SMIF Setup window is displayed as shown in Figure 2-13.

SMIF Indexer/LPO Options

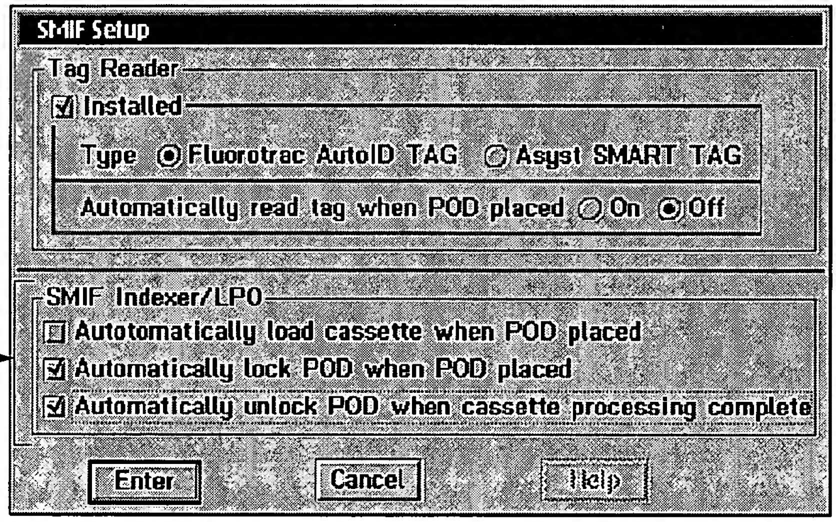


Figure 2-13. SMIF Setup Window — SMIF Indexer Options

3. Using the information in the table below, set the SMIF Indexer options as required then click on **[Enter]** to return to the Setup program Main window.

Table 2-12. SMIF Indexer Configuration Options

Option	Description
Automatically Load Cassette	Enabled: System automatically clamps the pod and loads the cassette into the system when the pod is placed on the port. Disabled: System does not perform any action on the pod.
Automatically Lock Pod	Enabled: System automatically clamps the pod when the pod is placed on the port. Disabled: System does not perform any action on the pod.
Automatically Unlock Pod	Enabled: System automatically unclamps the pod when the cassette is completely processed and the cassette has been unloaded back into the pod. Disabled: System does not unclamp the pod when the cassette is completely processed and the cassette has been unloaded back into the pod.

Tag Reader Configuration

The Tag Reader is configured through the **Setup** program.

1. Start the Setup program using the instructions provided in "Starting the Setup Program" on page AD A–10.
2. Select **Setup** from the Main menu, then select **Hardware** from the Setup menu. Select **SMIF** when the Hardware menu is displayed.

The SMIF Setup window is displayed as shown in Figure 2-14.

Tag Reader Options

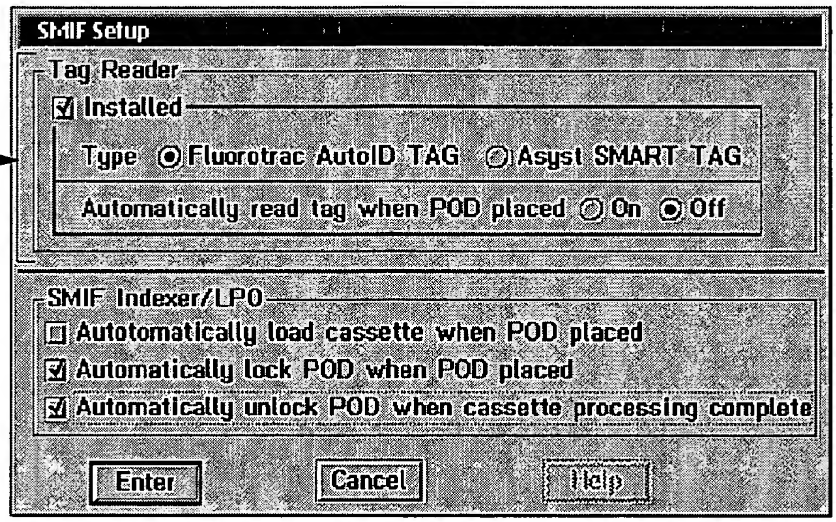


Figure 2-14. SMIF Setup Window — Tag Reader Options

3. Using the information in the table below, set the Tag Reader options as required then click on **[Enter]** to return to the Setup program Main window.

Table 2-13. Tag Reader Configuration Options

Option	Description
Installed	Enabled: Indicates a Tag Reader is installed on the system and tag reading is enabled. Disabled: A Tag Reader is not installed.
Type	Indicates the type of Tag Reader installed on the system: • Fluorotrac AutoID TAG • Asyst SMART TAG
Automatically Read Tag	On: The Tag is read by the Tag Reader when the Pod is placed. Off: The Tag is not read by the Tag Reader when the Pod is placed. Either the operator or the host must initiate tag reading manually.

Cassette Mapping Configuration

The purpose of cassette mapping is to verify that wafers are present in the slots to be measured and that no wafers are cross-slotted or double-slotted in the cassette. Cassette mapping is performed by a device on the robot.

The Cassette Map Reader is configured through the **Setup** program.

1. Start the Setup program using the instructions provided in "Starting the Setup Program" on page AD A–10.

2. Select **Setup** from the Main menu, then select **Hardware** from the Setup menu. Select **Cassette Mapping** when the Hardware menu is displayed.

   The Cassette Mapping Setup window is displayed as shown in Figure 2-15.

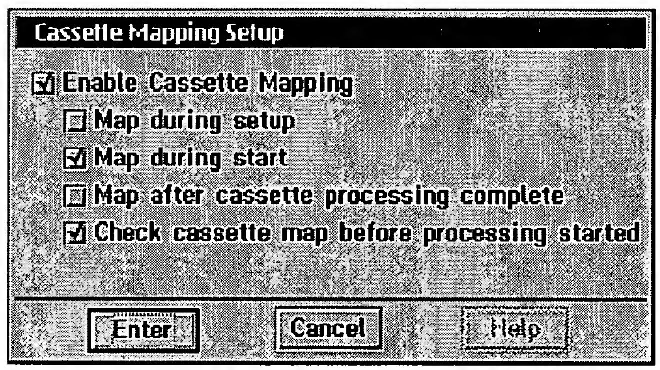


Figure 2-15. Cassette Mapping Setup Window

3. Using the information in the table below, set the Tag Reader options as required then click on **[Enter]** to return to the Setup program Main window.

Table 2-14. Tag Reader Configuration Options

Option	Description
Enable Cassette Mapping	Enabled: Indicates that cassette mapping is enabled. Disabled: Indicates that cassette mapping is disabled.
Map During Setup	Enables cassette mapping during Setup (selection) of the Cassette Processing Recipe. The cassette is checked that a wafer is present in all slots that are to be measured. The cassette slots to be measured are also checked for cross slotting errors.

Continued on next page

Table 2-14. Tag Reader Configuration Options (Continued)

Option	Description
Map During Start	Enables cassette mapping during the start of cassette processing. The cassette is checked that a wafer is present in all slots that are to be measured. The cassette slots to be measured are also checked for cross slotting errors.
Map After Cassette Processing Complete	Enables cassette mapping after the cassette is complete. The cassette is also checked to verify that all wafers that were processed are present in the cassette.
Check Cassette Map Before Processing Started	Enables cassette map verification when cassette processing is started. This checkbox is only valid if **Map During Setup** or **Map During Start** is enabled.

Process Start Options

The Process Start options are configured through the **Setup** program.

1. Start the Setup program using the instructions provided in "Starting the Setup Program" on page AD A–10.
2. Select **Setup** from the Main menu, then select **Operator** from the Setup menu.

The Operator Setup window is displayed as shown in Figure 2-16.

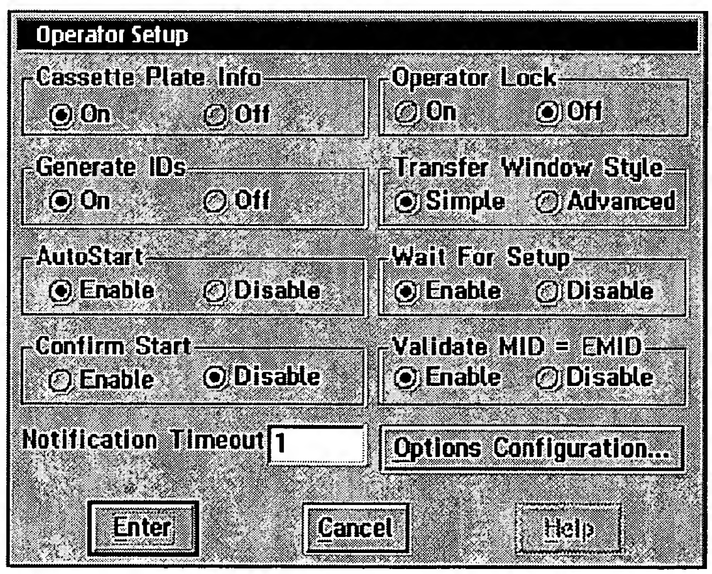


Figure 2-16. Operator Setup Window

3. Using the information in the table below, set the Process Start options as required. Table 2-16 shows the interactions between the AutoStart and Confirm-Start options.

   Click on **[Enter]** to return to the Setup program Main window when all options have been selected.

Table 2-15. Process Start Options

Option	Description
AutoStart	Enabled: System automatically starts processing the cassette after the process program has been set up (PP-SELECT). Disabled: System waits for the operator or host to initiate cassette processing.
Confirm Start	Enabled: The Operator must confirm that the MID and PPID about to be processed is correct. Disabled: Operator confirmation that the MID and PPID are correct is not required.
Wait For Setup	Enabled: System waits for the host to send an S2F41 SETUP command or an S2F41 UNLOCK command before confirming the EMID is equal to the MID. Disabled: System does not wait for the host to send an S2F41 SETUP command or an S2F41 UNLOCK command before confirming the EMID is equal to the MID.
Validate MID = EMID	Enabled: Check that the MID = EMID after PPID has been selected, and the EMID has been read from the AutoID system. Disabled: Do not check that the MID = EMID after PPID has been selected, and the EMID has been read from the AutoID system.
Notification Timeout	The time-out (in seconds) for advanced notification of cassette complete.

Table 2-16. AutoStart/Confirm-Start Interaction

AutoStart	Confirm-Start	Description
Enabled	Disabled	Automatic start, if AutoID verification (MID=EMID) successful.
Disabled	Enabled	Two-level confirmation: • Load/Start by Operator/Host • Final confirmation by Operator
Disabled	Disabled	Load/Start command from Host or Operator is needed. Operator not needed if Host issues Start.
Enabled	Enabled	No Load/Start command needed. One-level Operator confirmation is required.

Appendix A

Starting and Stopping the System

Introduction

This appendix provides detailed procedures for starting and stopping your *Meta*PULSE System.

The topics covered in this appendix include:

SECURITY NOTICE

Exiting the Operator program is subject to system security. If you do not have the appropriate access levels, you will be prevented from exiting the Operator program.

NOTE

The procedures in this guide assume that once the *Meta*PULSE System is started after installation it will be left on. The shutdown procedures are provided for possible service requirements or emergency situations.

*Meta*PULSE System Power Control Panel

All *Meta*PULSE Systems have one or more power control panels that allow you to power the system on and off under both normal and emergency conditions.

Depending on the type of system (either *Meta*PULSE 200 or *Meta*PULSE 300), the power control panel(s) will have one or both of the following switches:

- **Emergency Machine Off (EMO) switch** — Large red switch for emergency use. Pressing this switch shuts down the system including all airflow and the computer. A vacuum ballast maintains vacuum to the robot arm to hold a wafer (if present) in place. The EMO switch must be reset before power may be re-applied.
- **Power On/Off switch** — Green switch (located to the right of the EMO switch) used to turn the system on and off under normal operating conditions.

CAUTION

Any information not yet stored to disk is lost when either switch is pressed.

*Meta*PULSE 200 System

*Meta*PULSE 200 Systems have one power control panel located on the Measurement Module to the right of the video display. Both a Power On/Off and an Emergency Machine Off (EMO) switch are available.

The power control panel is shown in Figure A-1 on page AD A–3. See Figure 1-1 on page AD 1–2 for the location of the power control panel.

*Meta*PULSE 300 System

*Meta*PULSE 300 Systems have two power control panels: one on the cleanroom side of the unit (front) and one on the chase side (rear).

The power control panel on the chase side is located on the Main User Interface (as shown in Figure 1-2 on page AD 1–5). Both a Power On/Off switch and an Emergency Machine Off (EMO) switch are available on this power control panel.

The power control panel on the cleanroom side is located above and between the two load ports (as shown in Figure 1-3 on page AD 1–6). Only an Emergency Machine Off (EMO) switch is available on this power control panel.

NOTE

A Power On/Off switch is also provided on the Optional User Interface Module.

Figure A-1 shows the power control panel that is on *Meta*PULSE 200 Systems and on the chase side (rear) of *Meta*PULSE 300 Systems.

Figure A-2 shows the power control panel that is on the cleanroom side (front) of *Meta*PULSE 300 Systems.

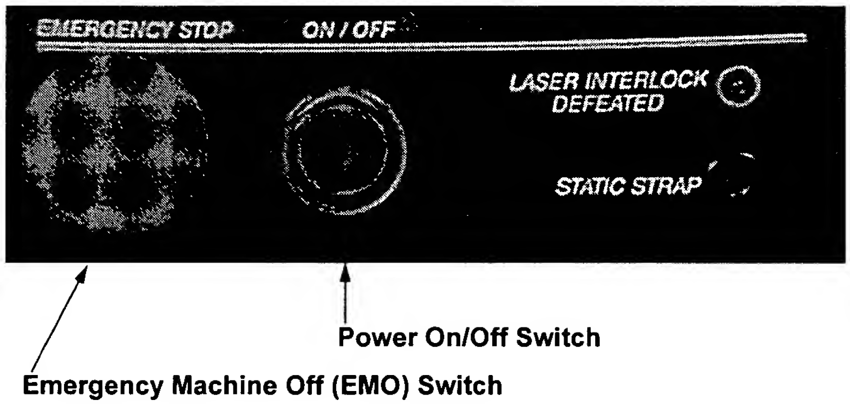


Figure A-1. Power Control Panel — *Meta*PULSE 200 and *Meta*PULSE 300 (Chase)

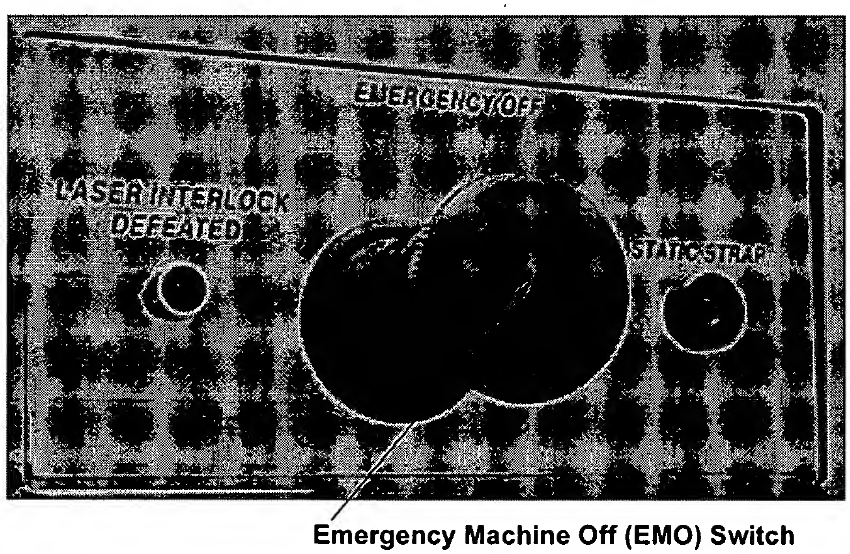


Figure A-2. Power Control Panel — *Meta*PULSE 300 (Cleanroom)

*Meta*PULSE Laser Control Panel

Each *Meta*PULSE System is equipped with a Laser Control Panel. On a *Meta*PULSE 200 System, the Laser Control Panel is located inside the Robot Module. On a *Meta*PULSE 300 System, the Laser Control Panel is located on the bottom shelf.

The Laser Control Panel is shown in Figure A-3. The Laser Starter Key and the Laser Control Menu keys are highlighted.

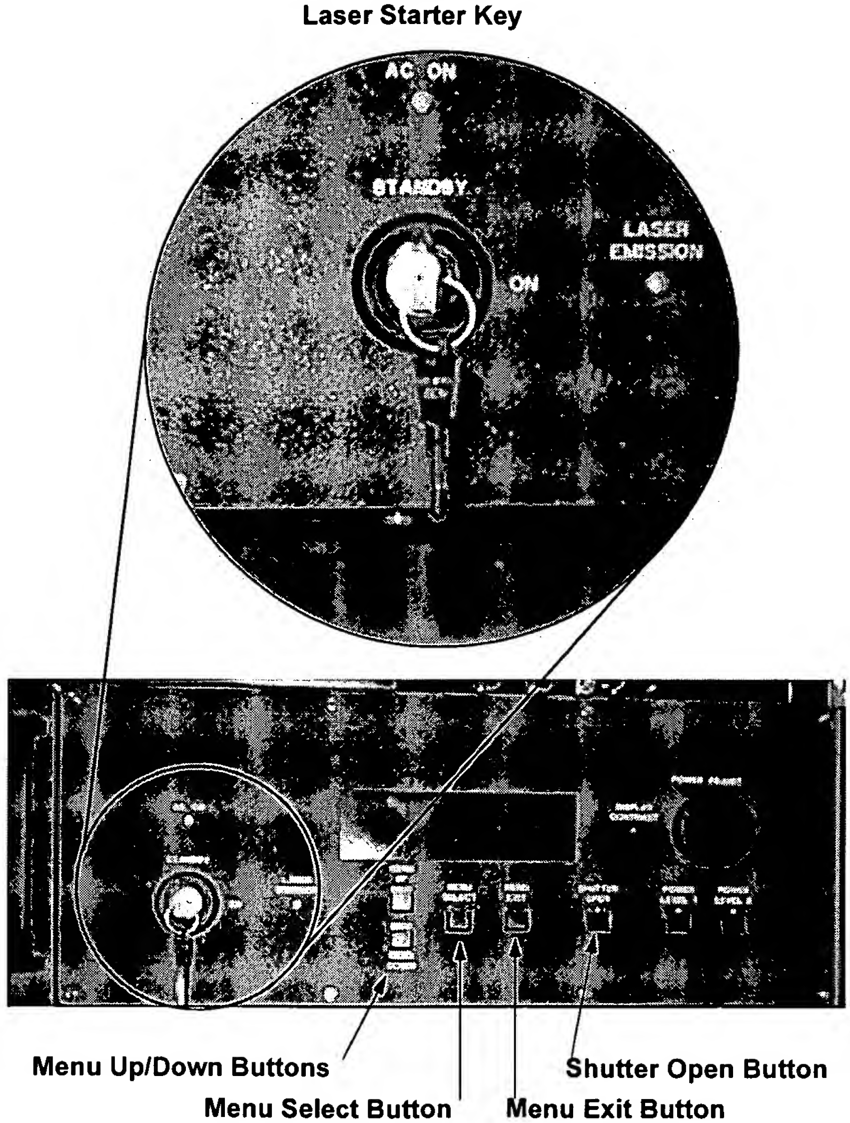
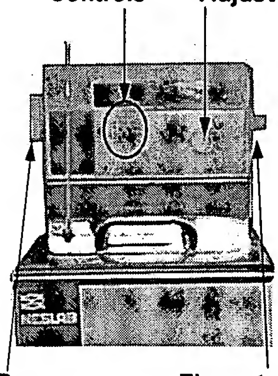


Figure A-3. Laser Control Panel

Normal System Startup



To startup your *Meta*PULSE System, use the following procedure:

1. Ensure that all facilities (water, air, and vacuum) are connected to the system, and that power is available (the power cord is plugged into the wall outlet and the main power breaker for that outlet is turned on).

2. Perform the following steps on the Chiller Module:
   - Turn on the Chiller Module.
   - Set the temperature to **25°C**.
   - Set the Refrigeration and Flow Rate to **MAX**.

3. Warm up the laser by performing the following steps from the Laser Control Panel (refer to Figure A-3 on page AD A–4):
   - Turn the Laser Starter Key to the **STANDBY** position.
   - Press the **Menu Select** button then press the **Menu Up/Down** arrow buttons until **LBO Temperature Settings** is displayed.
   - Press the **Menu Select** button to begin heating the laser LBO crystal.
   - Press the **Menu Exit** button until the main screen with the laser status summary is displayed. While the laser is warming up, continue with the next step.

NOTE

After approximately 45 minutes the message "All Servos Locked" appears, signifying that the laser has warmed up. After this message is displayed, the Laser Starter Key may be turned to the "On" position.

CAUTION

Do not turn the Laser Starter Key to the "ON" position before the "All Servos Locked" message is displayed.

4. Remove any disks from the floppy disk drive and press the green Power On/Off switch on the *Meta*PULSE System power control panel (Figure A-1 on page AD A–3) while the laser is warming up.

   The computer operating system boots up and the OS/2 desktop is displayed. If for some reason the computer does not boot up, press the computer **Reset** button. Figure A-4 shows the location of the Reset button.

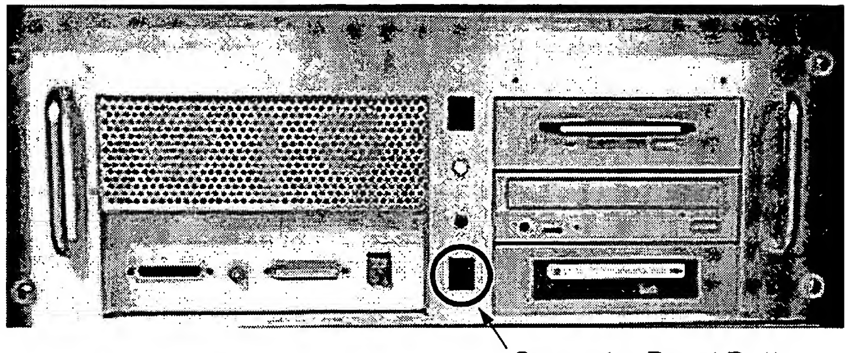


Figure A-4. Computer Reset Button Location

5. On the Laser Control Panel, verify that the message **All Servos Locked** is displayed. Turn the Laser Starter Key to the **ON** position and press the **Shutter Open** button on the Laser Control Panel (refer to Figure A-3 on page AD A–4).

6. If the system power has been off for an extended period of time (longer than one hour), the system should be allowed to warm up for at least one hour before attempting to take measurements.

NOTE

The *Meta*PULSE Operator program may be started during the warm up period if desired. This will allow the system self-check software to calibrate the system during the warm-up period. Refer to "Starting the Operator Program" on page AD A–12.

7. If not started during the warm up period in Step 6, start the *Meta*PULSE Operator program using the instructions provided in "Starting the Operator Program" on page AD A–12.

   The stage, robot, vision processor, and SECS-II connections (if available) initialize when the Operator program is started.

8. When the *Meta*PULSE Operator program is running, log in as **Admin** (refer to "Logging In to the Operator Program" on page AD A–14). Select **System** from the Main menu then select **Self Check** when the System menu is displayed.

   The system performs a self-check. Once completed, the system is ready for use.

Normal System Shutdown

To perform a normal System shutdown, use the following procedure:

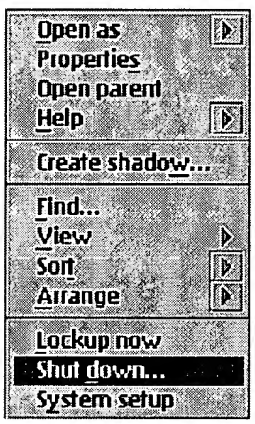
CAUTION

The *Meta*PULSE System should be allowed to run for a minimum of 24 hours. Excessive startup and shutdown of the system may decrease the life of the laser diode.

1. Remove all wafers from the stage and the robot either automatically or manually by using a vacuum wand.
2. Exit the *Meta*PULSE Operator program using the procedures in "Exiting the Operator Program" on page AD A–17.

   You are returned to the OS/2 desktop.
3. Remove any disks from the floppy drive.
4. RIGHT click on the OS/2 desktop background (not in a window).

   A menu of OS/2 system commands is displayed.



5. Select **Shut down** from the menu.

   The computer shuts down. A message is displayed when the shutdown is complete stating that it is safe to turn off the system.
6. Press the green Power On/Off switch on the *Meta*PULSE System power control panel to turn off the system. The laser power supply will continue to draw power, however all lasing will stop.
7. If shutting down the *Meta*PULSE System for an extended period of time, continue with Step 8. Otherwise, proceed to Step 10.
8. Perform the following steps from the Laser Control Panel (refer to Figure A-3 on page AD A–4):
   - Turn the Laser Starter Key to the **STANDBY** position.
   - Press the **Menu Select** button then press the **Menu Up/Down** arrow buttons until **LBO Temperature Settings** is displayed.
   - Press the **Menu Select** button to begin LBO cooling.
   - Press the **Menu Exit** button until the main screen with the laser status summary is displayed.
9. After the laser is in STANDBY mode, or is turned OFF, turn off the Chiller Module.
10. When the System is powered off, the power cord can be removed from the outlet or the main power breaker may be shut off. You may also disconnect the vacuum, air, and water lines if desired.

Emergency System Shutdown

To perform an emergency System shutdown, press the red Emergency Machine Off (EMO) switch on the *Meta*PULSE System power control panel (refer to Figure A-1 and Figure A-2 on page AD A–3).

When the switch is pressed the following will occur:

1. The stage and robot will stop moving.
2. The laser shutters will close and the laser will turn off.
3. The *Meta*PULSE System shuts down (including the computer). The laser also is shut down and all air flow around and through the unit is stopped. A vacuum ballast maintains vacuum to the robot arm to hold a wafer (if present) in place.

CAUTION

Any information not already saved to disk is lost.

Recover from an Emergency System Shutdown

After the Emergency Machine Off (EMO) switch has been pressed and the *Meta*PULSE System is shutdown, perform the following to restart the System:

1. Press the green Power On/Off switch on the power control panel (refer to Figure A-1 on page AD A–3) one time to set it to the "off" position.

NOTE

The next step must be performed with the power off to ensure a proper recovery.

2. Reset the EMO switch by rotating the switch in a clockwise direction until it clicks into place.
3. Refer to "Normal System Startup" on page AD A–5 for information on restarting the system.

   If any wafers were left on the robot or stage, the system will prompt you to enter a destination slot to which the wafer will be returned.

Starting and Exiting System Applications

All *Meta*PULSE System applications are located in the RTI Applications folder on the OS/2 desktop, as shown in Figure A-5.

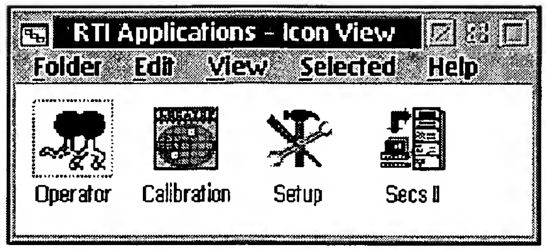


Figure A-5. RTI Applications Folder (OS/2 Desktop)

The sections that follow provide basic instructions for starting and exiting the *Meta*PULSE Setup and Operator applications. For information on how to use the Operator and Setup applications to configure your *Meta*PULSE System, refer to Chapter 2, "System Configuration".

Additional information on using the *Meta*PULSE Operator program is available in the following manuals:

- Operating Your *Meta*PULSE™ System (Part Number A16203)
- *Meta*PULSE™ Applications Development Guide (Part Number A17994)

Information on using the *Meta*PULSE SECS-II program is available in VANGUARD™ SECS-II/GEM Interface Specifications (Part Number A17792).

The *Meta*PULSE Calibration program is to be used only under the direction of Rudolph Technologies support personnel.

Starting the Setup Program

To start the *Meta*PULSE Setup program, double click on the **Setup** icon that is located in the **RTI Applications** folder on the OS/2 desktop.

NOTE

The Setup program will not run if the Operator or Calibration program is already running.

After an introductory screen is displayed briefly, the *Meta*PULSE Setup main window is displayed as shown in Figure A-6.

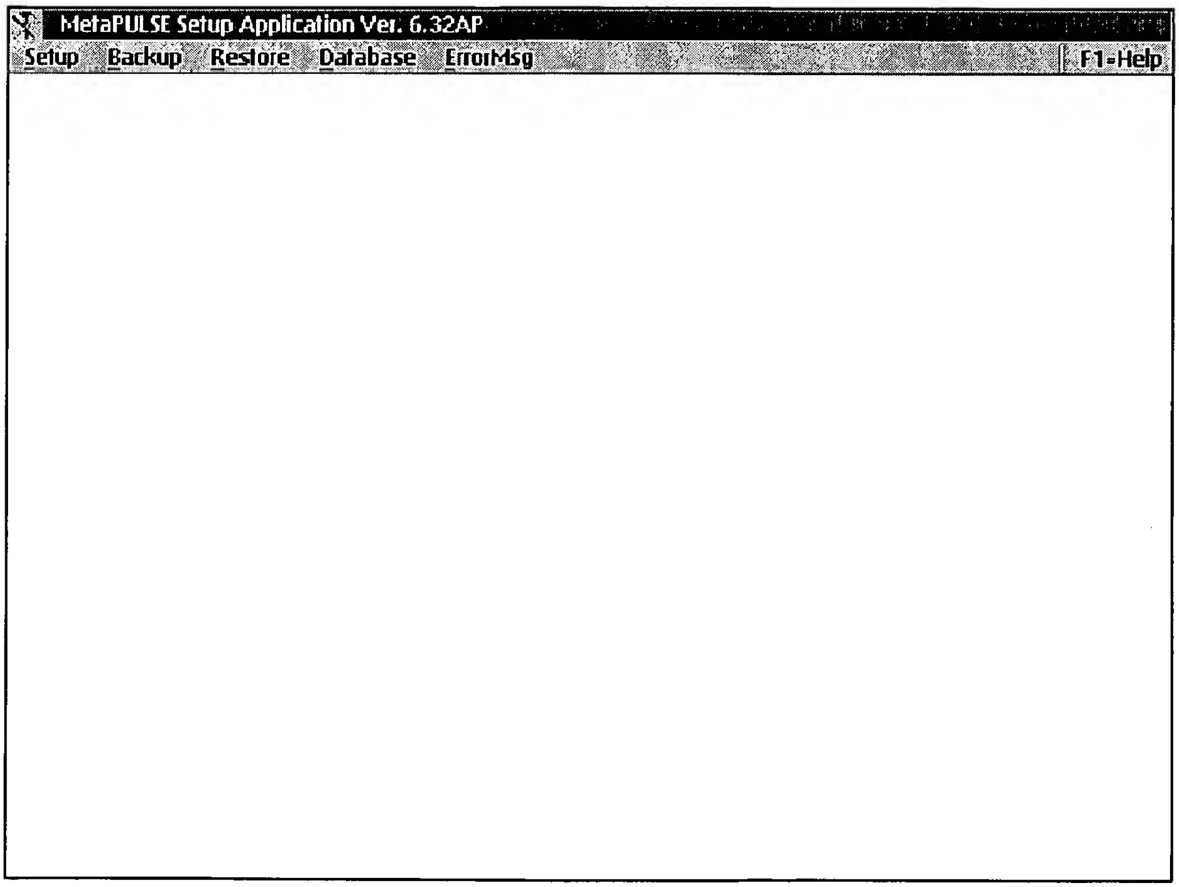


Figure A-6. *Meta*PULSE Setup Main Window

Refer to Chapter 2, "System Configuration" for descriptions of the menu items available in the Setup program, and for detailed procedures for using the Setup program to configure your *Meta*PULSE System.

Exiting the Setup Program

To exit the *Meta*PULSE Setup program, perform the following procedure:

1. With the *Meta*PULSE Setup main window displayed (as shown in Figure A-7), perform **one** of the following:

   - Double click on the Window Menu icon located in the upper left corner of the window (beside the **MetaPULSE Setup Application** program name).

   - Click on the Window Menu icon located in the upper left corner of the window (beside the **MetaPULSE Setup Application** program name). Select **Close** from the menu that is displayed.

   The *Meta*PULSE Setup program exits and you are returned to the OS/2 desktop.

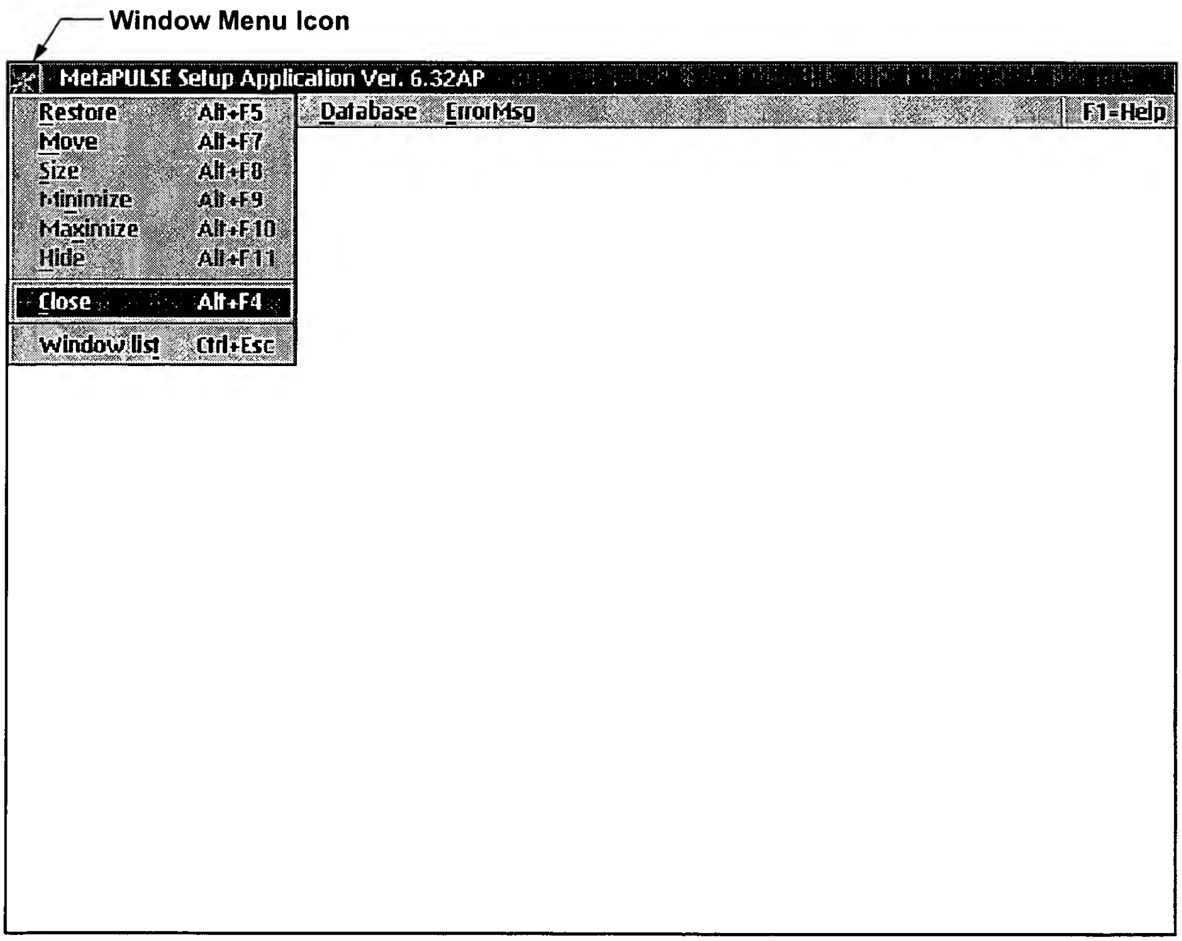


Figure A-7. *Meta*PULSE Setup Main Window (Window Menu Displayed)

Starting the Operator Program

To start the *Meta*PULSE Operator program, double click the **Operator** icon located in the **RTI Applications** folder on the OS/2 desktop.

After an introductory screen, the Cassette Run View is displayed. The appearance of the Cassette Run View will vary depending upon whether this is a *Meta*PULSE 200 or *Meta*PULSE 300 System. The screen shown in Figure A-8 is displayed on a *Meta*PULSE 200 System.

NOTE

The first time the Operator program is started after a system shutdown and startup, the robot, stage, and vision subsystems will need to initialize (as will the optional tilters and SECS interface if your system is so equipped). This may take up to 5 minutes to complete.

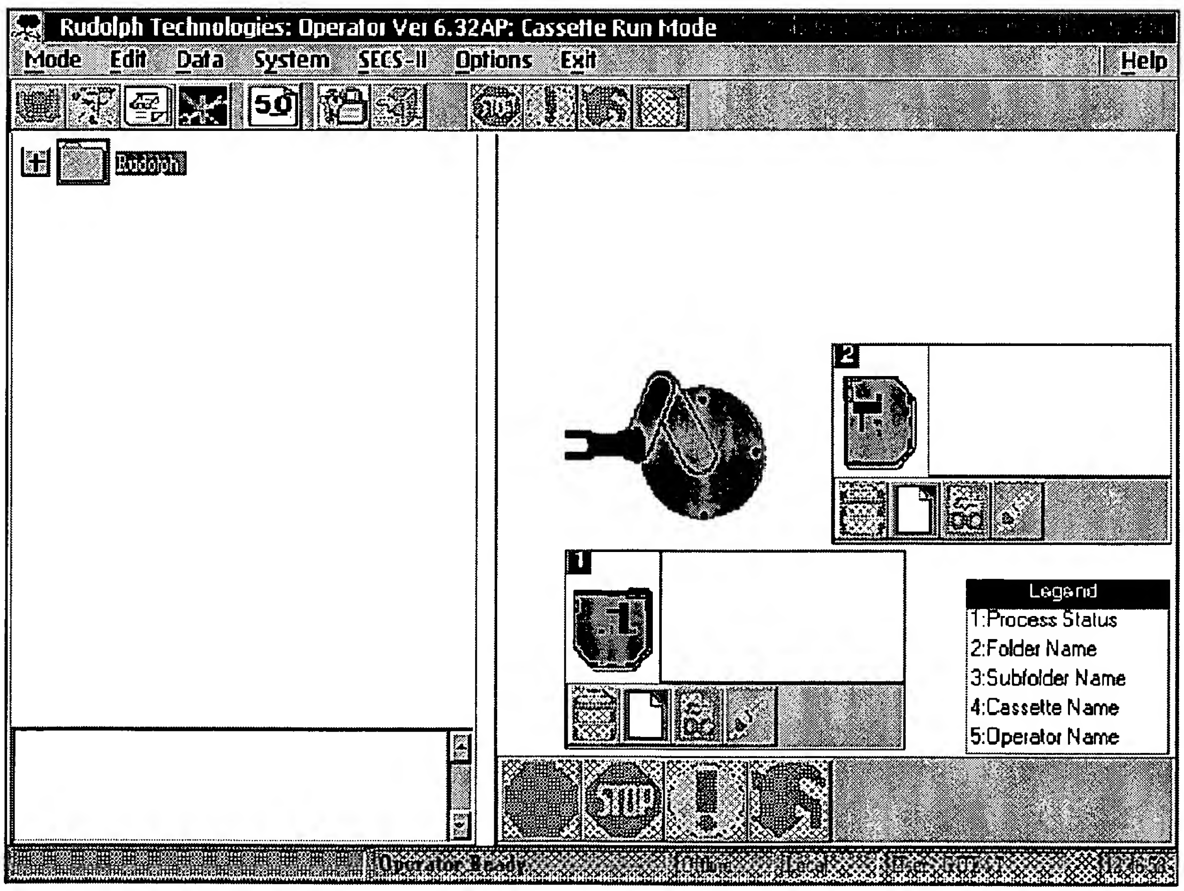


Figure A-8. Cassette Run View (*Meta*PULSE 200 System)

When the *Meta*PULSE Operator program is first started, you are automatically logged in as user **Guest**.

While logged in as **Guest**, the actions that you are permitted to perform are determined by the system security configuration and the access privileges set by the Administrator for the Guest account.

- **If system security is not enabled:** no protection is enforced and you are permitted to perform any action.
- **If system security is enabled, but logins are disabled:** the Guest user has very limited privileges. You are permitted to browse the recipe database, run Cassette recipes and switch to and from various operating modes (depending upon system configuration).
- **If system security and logins are enabled:** access to certain operating modes and functions, and to the recipe database editing functions (creating, modifying, deleting, etc.) are determined by the security profile for each user (including the Guest user) as configured by the system administrator.

  If logged in as **Guest** (or as a user that does not have permission to perform the selected action), the User Login window will be displayed (as shown in Figure A-9 on page AD A–15) when a protected area or object is accessed. Refer to "Logging In and Logging Out of the Operator Program" on page A–14 for information on how to log in to the system.

Once you have started the *Meta*PULSE Operator program and logged in (if required), refer to Chapter 2, "System Configuration" for information on how to access and use the administrative functions of the Operator program to configure the system users and groups.

Information on using the *Meta*PULSE Setup program to configure the *Meta*PULSE hardware and system security is also available in Chapter 2, "System Configuration".

Information on editing the recipe database, creating or modifying recipes (and the components that make up a recipe), and retrieving and/or manipulating measurement data (including the creation of wafer maps and graphs), is available in the *Meta*PULSE™ Applications Development Guide (Part Number A17994).

Information on browsing the recipe database, selecting a Cassette recipe to run, and performing wafer measurements is available in Operating Your *Meta*PULSE™ System (Part Number A16203).

Logging In and Logging Out of the Operator Program

Your system may be configured to require a log in before you are permitted to perform certain tasks. This configuration can be set in either of two ways:

- A log in is required each time you attempt to access a protected resource or perform a privileged task. Once you have completed the selected function, the system automatically logs you out and you are returned to the **Guest** login.

- A log in is required only the first time you attempt to access a protected resource or perform a privileged task. When you have completed the selected function, the system does not log you out automatically. If you then attempt to perform a function for which your current login does not have permission, the system will prompt you to log in with a different name.

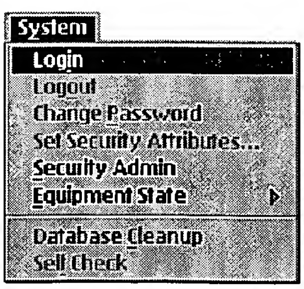
If system security is enabled, you may opt to manually log in prior to having the system prompt you to do so. However, the same conditions apply as listed above regarding the automatic logout after completing the selected function.

Logging In to the Operator Program

Once you have started the *Meta*PULSE Operator program (see "Starting the Operator Program" on page AD A–12), you may manually log in by using either the Main menu or Tool Bar, or the system may automatically prompt you to log in when you attempt to access a protected function.

Use the following procedure to log in to the *Meta*PULSE System:

1. Perform **one** of the following:



- **To manually initiate a log in:** either select **System** from the Main menu then select **Login** from the System menu, or click on the **[Operator Login]** button in the Tool Bar. 

  The User Login window is displayed as shown in Figure A-9.

- **If the System prompts you to log in:** the User Login window is displayed as shown in Figure A-9. Continue with the next step.

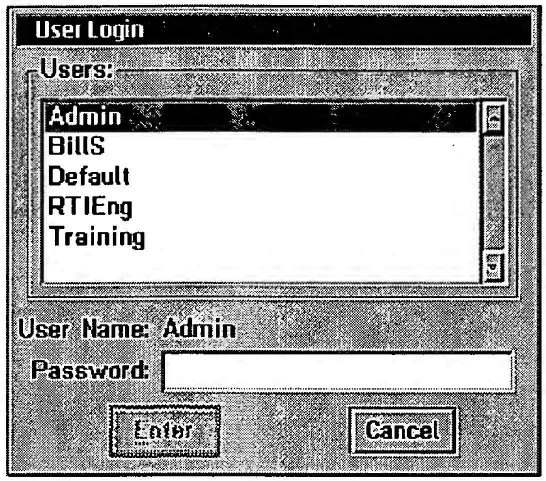


Figure A-9. User Login Window

2. Select your login name from the list.

   The name is highlighted and displayed in the **User Name** field.

SECURITY NOTICE

Passwords may or may not be required depending upon your system configuration.

3. Perform **one** of the following:

   - **If passwords are not required (Password field not displayed):** click on **[Enter]**.
   - **If passwords are required:** Click in the **Password** field of the User Login window, enter your password, then click on **[Enter]**.

SECURITY NOTICE

For security reasons, asterisks (*) will be displayed as you enter your password.

Passwords may or may not be case sensitive depending upon your system configuration.

Once a username/password pair has been entered that has the privilege level for the selected function, the login name is displayed in the Status Bar and you are granted access.

Logging Out of the Operator Program

Depending upon system configuration, you may be automatically logged out and returned to the **Guest** account once you have completed the current task.

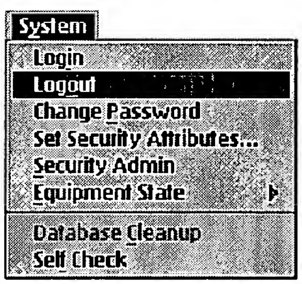
You may also log out of the *Meta*PULSE System manually by using either the Main menu or the Tool Bar.

NOTE

You cannot log out of the system if measurements are in progress or while the Mapping View is displayed.

Logging out via the Main Menu is not available when in Recipe Creation Mode. To log out, you must use the Tool Bar or switch to another operating mode in order to log out using the Main Menu.

Logging out via the Tool Bar is not available when the Wafer Recipe Editor window is displayed (Recipe Creation Mode). You must exit the Wafer Recipe Editor window in order to log out.



To manually log out, either select **System** from the Main menu then select **Logout** from the System menu, or click on the **[Operator Logout]** button in the Tool Bar. 

You are logged out of the System and returned to the **Guest** account.

Exiting the Operator Program

The *Meta*PULSE System may be configured in such a way as to require you to log in before exiting the *Meta*PULSE Operator program. If the System is configured in this manner, you will be permitted to exit the Operator program only if your login name has the specific permission levels to do so.

NOTE

You cannot exit the Operator program if measurements are in progress.

To exit the *Meta*PULSE Operator program, perform the following:

1. Ensure that no measurements are currently in progress and that you are in Cassette Run Mode.

2. Select **Exit** from the Main menu.

SECURITY NOTICE

If you do not have permission to exit the program, an error message is displayed.

A message is displayed asking you to verify that you wish to exit.

3. Perform **one** of the following:

   - **To exit the program:** click on **[Yes]**.

     The *Meta*PULSE Operator program exits and you are returned to the OS/2 desktop.

   - **To abort the exit and return to the program:** click on **[No]**.

     You are returned to the program.

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Menu Maps

Appendix B

Introduction

This appendix provides menu maps for the *Meta*PULSE **Operator** and **Setup** programs.

The menu maps provided in this chapter include:

*Meta*PULSE Operator menu maps for:

AD B–3 ➢ • Cassette Run Mode

AD B–4 ➢ • Recipe Creation Mode

AD B–6 ➢ • Data Review Mode

AD B–9 ➢ *Meta*PULSE Setup menu maps.

Operator Program Menu Maps

The sections that follow provide the menu maps for the *Meta*PULSE Operator program. Menu maps are provided for:

- Cassette Run Mode
  - Main Menu
  - Log Viewer Menu
- Recipe Creation Mode
  - Main Menu
  - Site Locator Window Menu
  - Filmstack Model Window Menu
- Data Review Mode
  - Main Menu
  - Cassette Run List Menu
  - Wafer Run List Menu
  - Film Parameter List Menu

NOTE

Not all menu items shown in the menu maps are available at the same time. Options that are not currently available will have the associated menu selection grayed out (ghosted).

Cassette Run Mode

The Cassette Run Mode Main menu is available from both the Cassette Run View and the Wafer View. The Log Viewer menu is available when viewing measurement data while measurements are in progress.

Main Menu

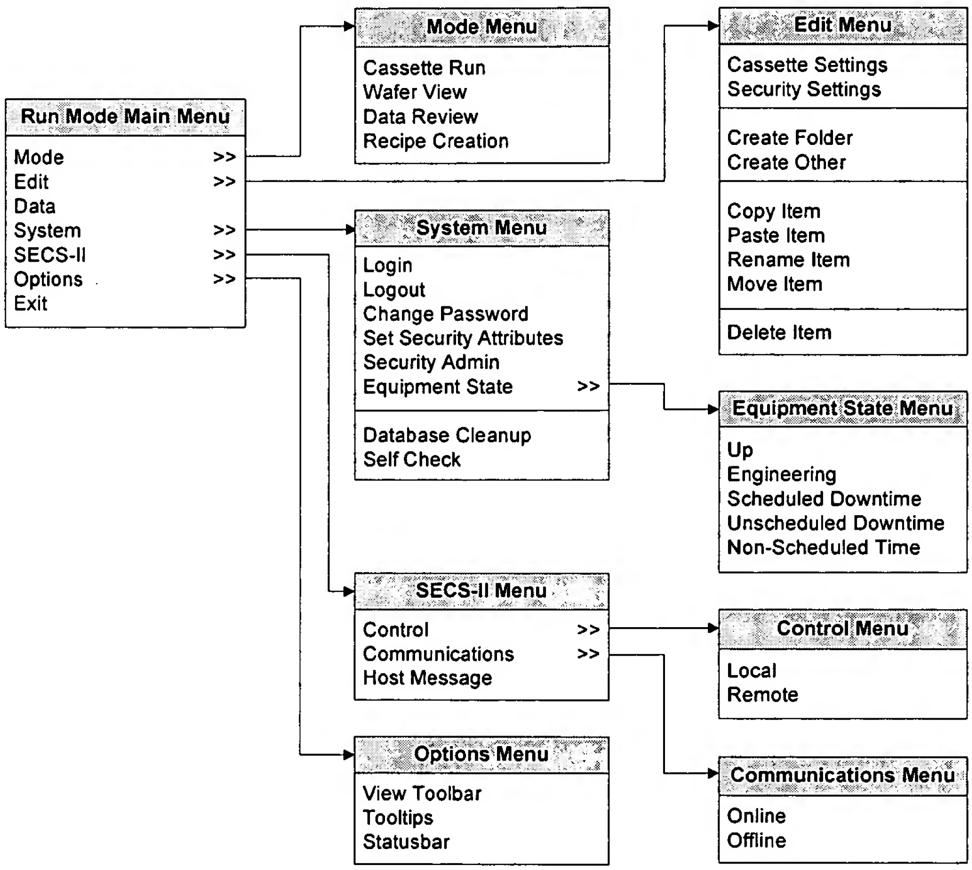

Figure B-1. Cassette Run Mode Main Menu (Cassette View and Wafer View)

Measurement Log Viewer

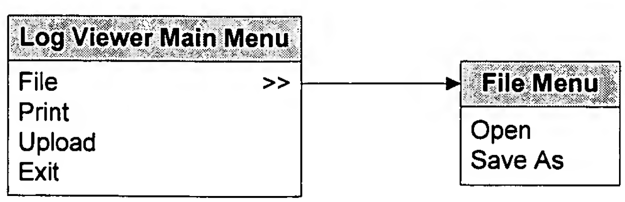

Figure B-2. Cassette Run Mode — Log Viewer Menu

Recipe Creation Mode

The Recipe Creation Mode Main menu is available from both the Recipe Selection Window and Wafer Recipe Editor Window. The Site Locator menu is available when editing a wafer recipe, and the Filmstack Model Window menu is available when editing a filmstack.

Main Menu

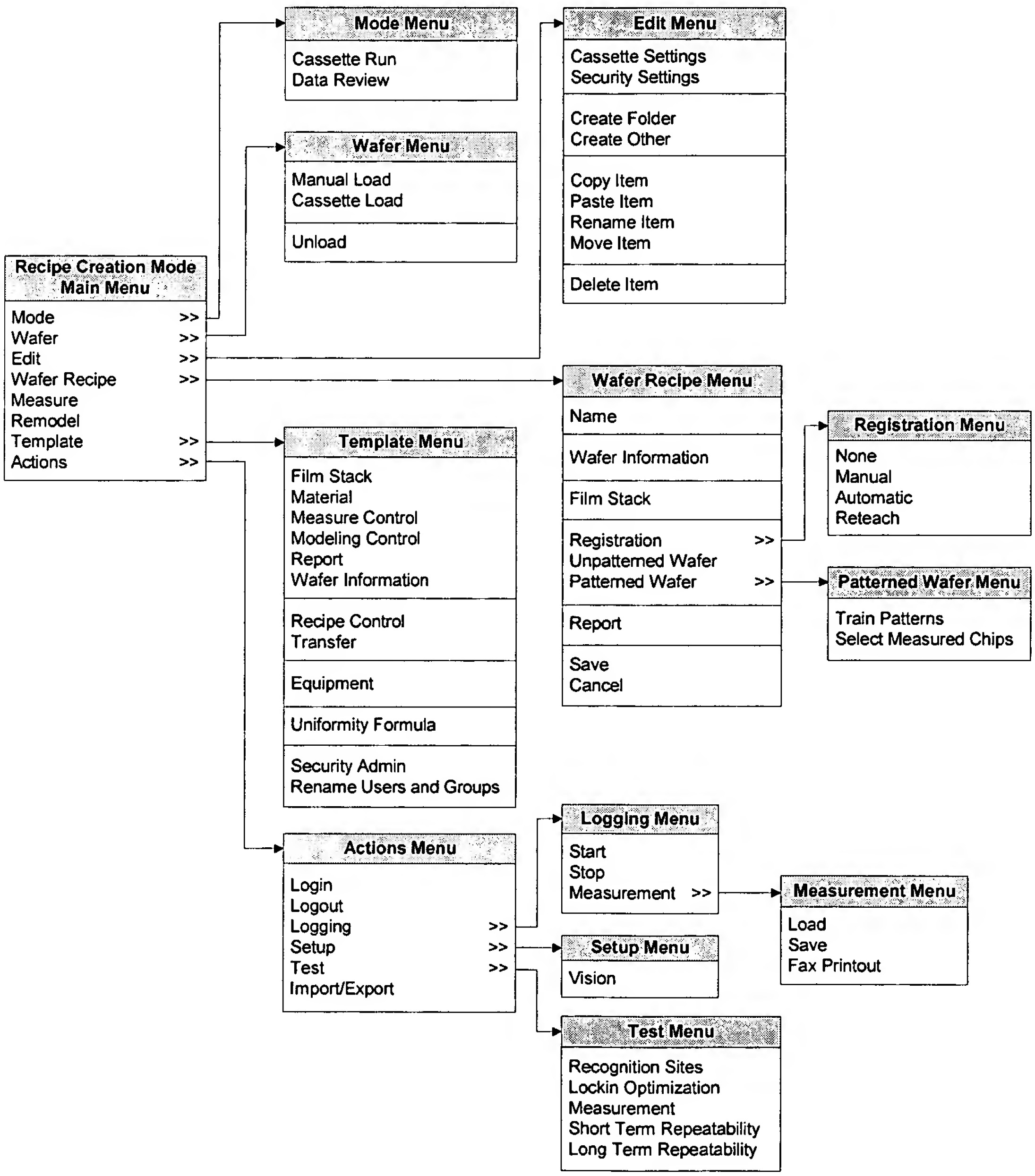

Figure B-3. Recipe Creation Mode Main Menu

Site Locator Window Menu

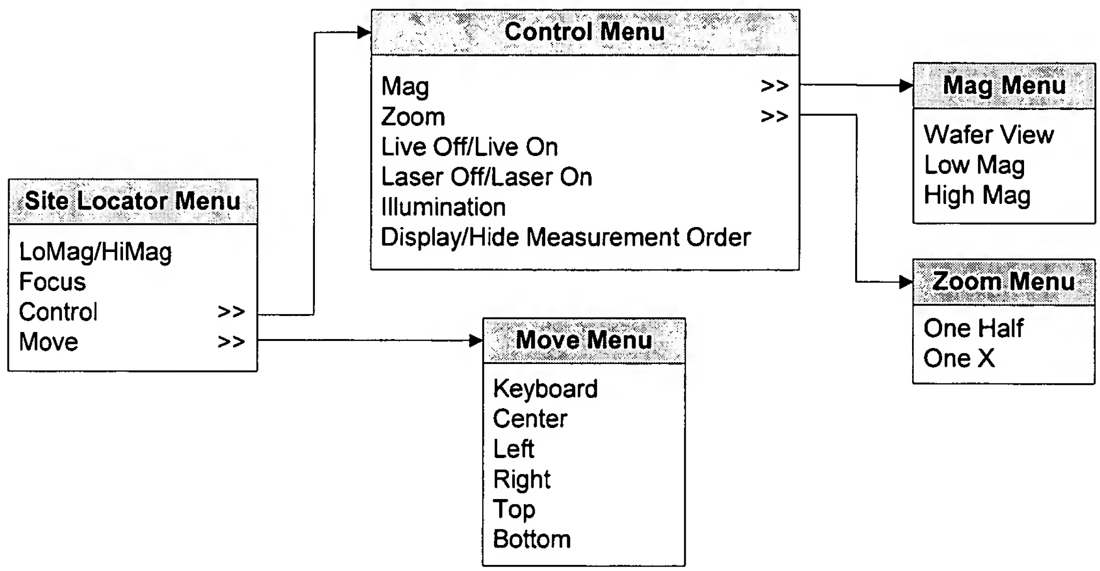

Figure B-4. Recipe Creation Mode — Site Locator Window Menu

Filmstack Model Window Menu

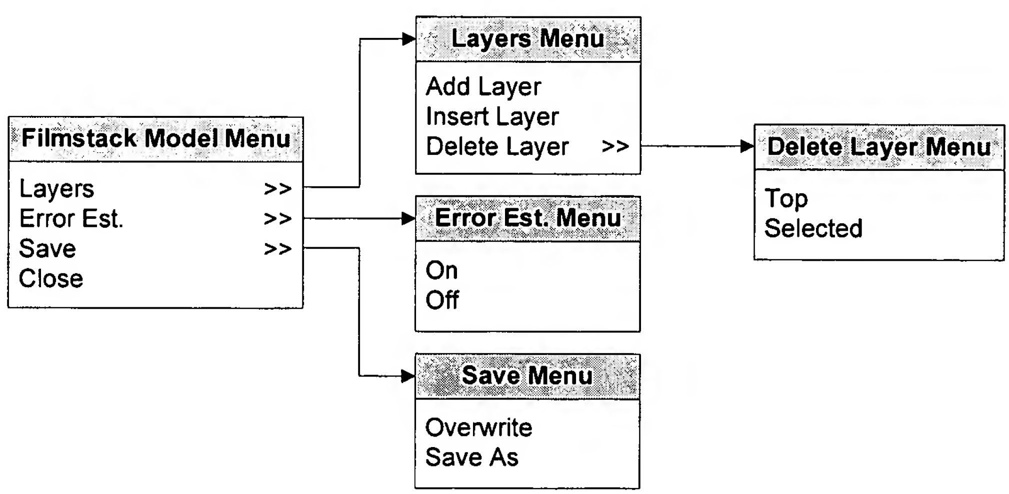

Figure B-5. Recipe Creation Mode — Filmstack Model Window Menu

Data Review Mode

The Data Review Mode Main menu, and the Cassette Run List, Wafer Run List, and Film Parameter List menus are available from the Data Review Mode Window.

Main Menu

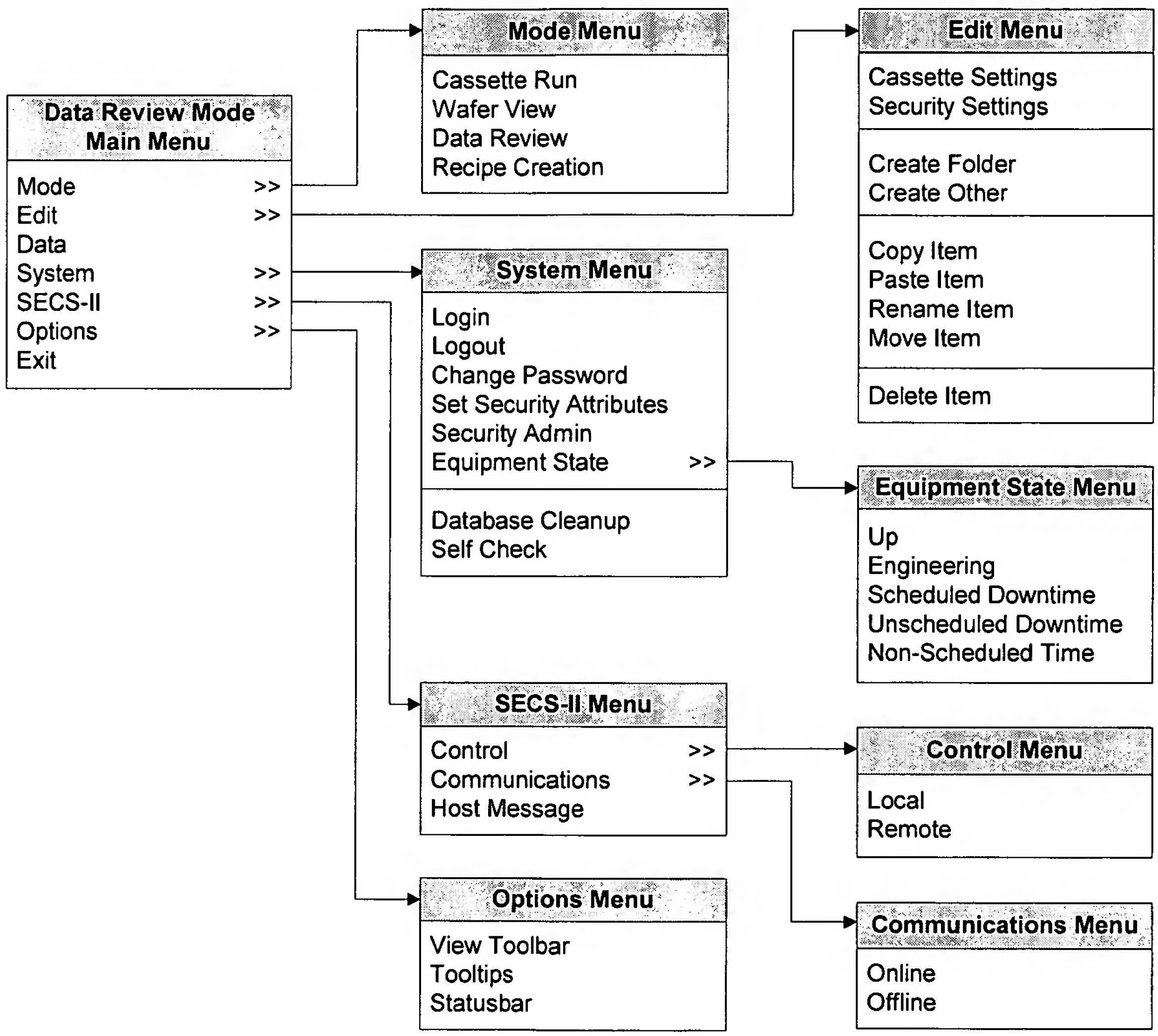

Figure B-6. Data Review Mode Main Menu

Cassette Run List Menu

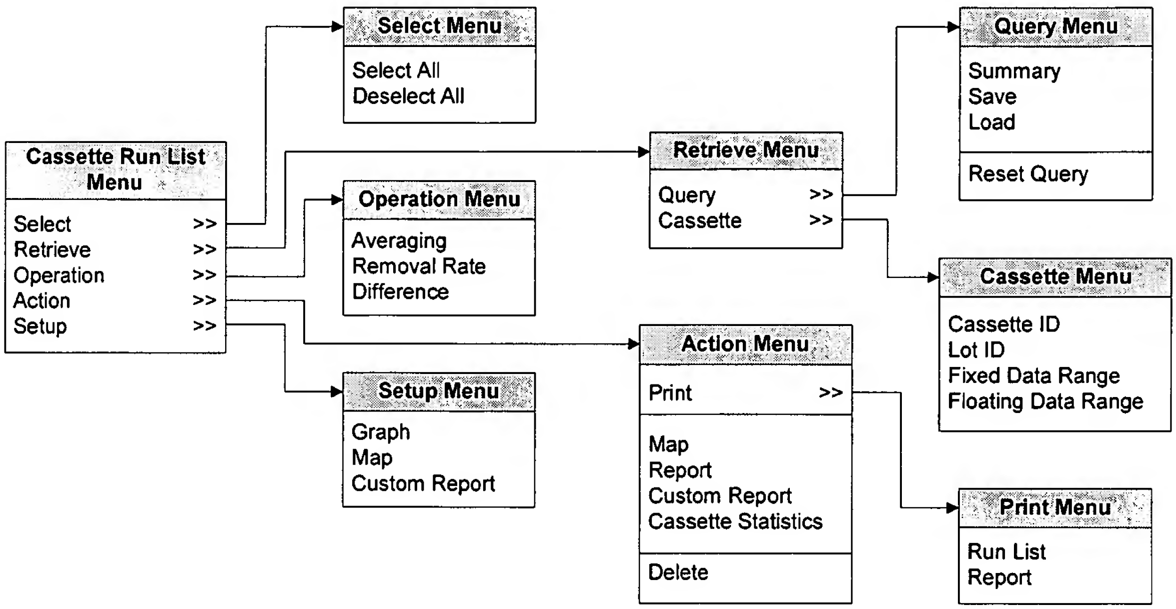

Figure B-7. Data Review Mode — Cassette Run List Menu

Wafer Run List Menu

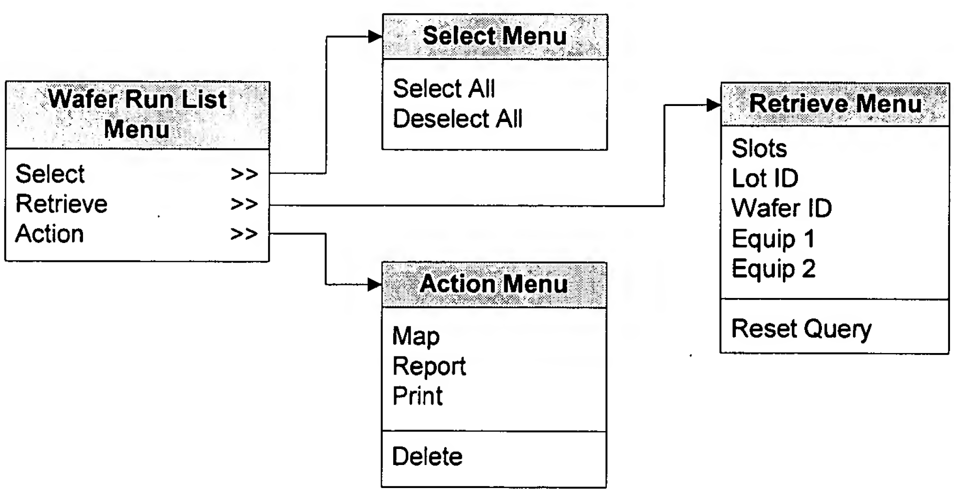

Figure B-8. Data Review Mode — Wafer Run List Menu

Film Parameter List Menu

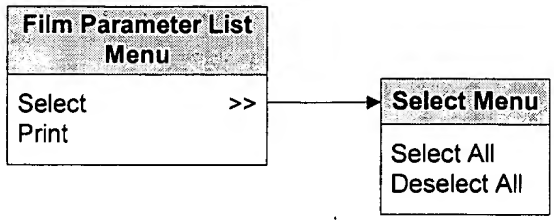

Figure B-9. Data Review Mode — Film Parameter List Menu

Setup Program Menu Maps

The sections that follow provide the menu maps for the *Meta*PULSE Setup program.

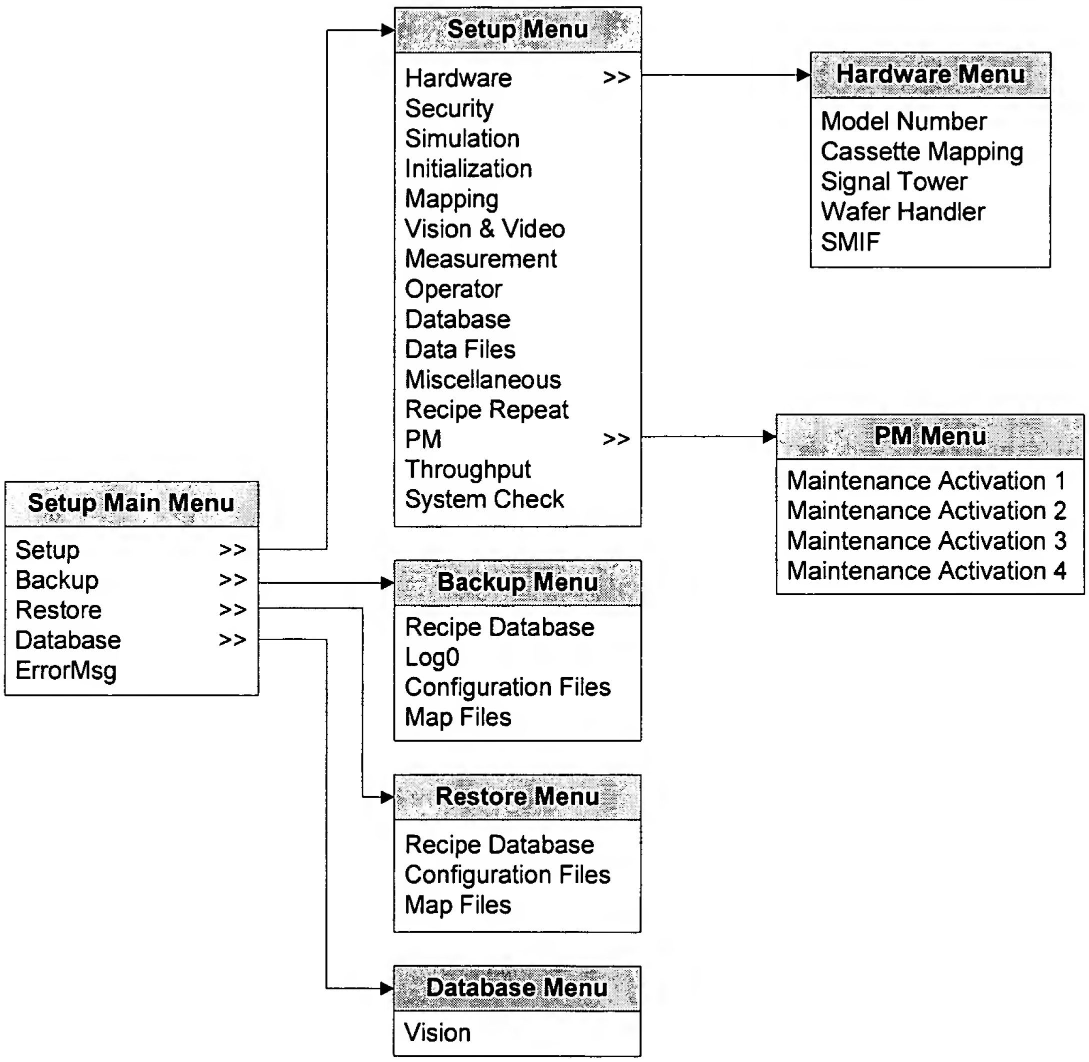

Figure B-10. Setup Program Main Menu

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Getting Help and Troubleshooting

Appendix C

Introduction

The purpose of this appendix is to provide you with some basic troubleshooting procedures and information on how to contact Rudolph Technologies for technical assistance and/or support for operational procedures, or in the event of a system error or failure.

The topics covered in this appendix include:

NOTE

Component replacement, repairs, optical alignment, and system calibration should not be attempted without first contacting Rudolph Technologies.

WARNING

Potentially hazardous voltages may be present in the *Meta*PULSE System and Chiller Module. Failure to follow proper safety precautions may result in serious personal injury or death. Electrical problems should be referred to qualified electricians or Rudolph Technologies support personnel.

In Case of Difficulty

The sections that follow provide some basic information to assist you in troubleshooting your *Meta*PULSE System and Chiller Module.

Use the information provided in "Contacting Rudolph Technologies" on page AD C–15 to get further assistance from Rudolph Technologies Support personnel.

*Meta*PULSE System

Use the information in the following table to troubleshoot possible problems with your *Meta*PULSE System. Locate the applicable symptom in the left column of the table to determine the possible causes and recommended actions to rectify the problem.

Table C-1. *Meta*PULSE System Trouble Symptoms

Symptoms	Possible Causes	Recommended Actions
1. Monitor screen is black	Monitor is off. No power to the monitor.	Press the white power button on the front of the monitor.
	Computer is off.	Restart the computer.
2. Operator window does not appear on the screen	Operator program is not running.	Double click the **Operator** icon from the RTI Applications folder. Wait for the software to load.
3. OS/2 icon does not appear in the Minimized Window Viewer—Icon View	OS/2 window is not open.	Click once on the OS/2 button on the desktop toolbar (bottom of the OS/2 desktop).
4. Cannot open Operator program	Calibration program is running.	Double click the **Calibration** icon. Log in with the proper password. Exit Calibration. Double click the **Operator** icon. Wait for the software to load.
	Setup program is running.	Double click the **Setup** icon. Log in with the proper password. Exit Setup. Double click the **Operator** icon. Wait for the software to load.
	Hardpipe Error.	Reset the computer. Wait for the software to load. Double click the **Operator** icon. Wait for the software to load.
5. Tool communication to station controller does not take place	Tool is in offline mode.	Verify that the tool is Online in the **Operator** program. Select **SECS-II** from the Main menu, then **Communications** from the SECS-II menu. Select the **Online** option.
	*Meta*PULSE SECS-II software is not running.	Check the Minimized Window Viewer—Icon View. Double click the **SECS-II** icon in the RTI Applications folder if the SECS-II application is not already running.
6. Cannot queue a cassette plate	Cassette is not properly loaded.	Check that the cassette is seated properly and that it is on the correct cassette plate.
	Cassette is warped.	Remove wafers to a new cassette.

Continued on next page

Table C-1. *Meta*PULSE System Trouble Symptoms (Continued)

Symptoms	Possible Causes	Recommended Actions
7. Robot will not pick up the correct wafer	Cassette slot or recipe specified is wrong.	Check that the correct recipe has been selected. Check that the proper wafer slots are occupied.
	Robot is not initialized.	Exit Operator then open **RRTest**. At the Command prompt type "**inr**" and wait while the robot initializes (approximately one minute). Restart **Operator**.
	Cassette plate/Tilter is not aligned.	Use the alternate cassette plate/tilter. Contact Rudolph personnel.
	Robot failure.	Contact Rudolph personnel.
8. *Meta*PULSE Modeling Application crashed in the middle of a run. This has occurred if the *Meta*PULSE Modeling icon does not appear in the Minimized Window Viewer—Icon View.	Cassette slot or recipe specified is wrong.	Check that the correct recipe has been selected and/or the proper wafer slots are occupied.
	Selected recipe was wrong.	Contact Rudolph Technologies to inspect raw data.
	Wafer may be misprocessed or out of control.	
9. Printer is printing blank pages or pages with missing colors.	Printer cartridge is empty.	Check both printer cartridges. Replace either one if necessary with spare cartridges.
10. Printer is not printing.	Printer is out of paper.	Refill paper tray. Bring the printer back on-line.
	Printer is off-line.	Check power and parallel cables to printer. Bring the printer on-line. Refer to the documentation provided with the printer for information.
11. Cannot save file to disk.	Hard disk space is too low.	Save files temporarily to the **e:\temp** directory or to a blank floppy or Jaz disk. Inform Rudolph personnel.
12. Data displays very large fit errors.	Wrong recipe is selected.	Abort the current cassette run. Select a different recipe.
13. Data displays solver errors.	Wrong recipe is selected.	Abort the current cassette run. Select a different recipe.
	Wrong wafer is being measured.	Verify that the wafer being measured is appropriate for the selected recipe.
	Wafer may be misprocessed or out of control.	Contact Rudolph Technologies to inspect raw data.
14. Computer freezes.		Power down the computer. Eject any floppy and/or Jaz disks. Restart the computer. Wait for the software to load. Double click the **Operator** icon. Wait for the software to load.

Continued on next page

Table C-1. *Meta*PULSE System Trouble Symptoms (Continued)

Symptoms	Possible Causes	Recommended Actions
15. Computer freezes with a wafer on the stage.		Power down the computer. Eject any floppy and/or Jaz disks. Restart the computer. Wait for the software to load. Double click the **Operator** icon and follow instructions for unloading the wafer from the stage by choosing the proper cassette and slot number. **Caution: The tool will not remember the proper slot number. Double check that the destination slot is correct before unloading wafer.**
16. Robot will not move.	Robot is not initialized. Robot has failed.	Exit Operator then open **RRTest**. At the Command prompt, type "**inr**" and wait while the robot initializes (approximately one minute). Restart **Operator**. Contact Rudolph personnel.
17. Stage will not move.	Stage is not initialized. Stage communication is lost. Stage has failed.	Exit Operator then open **RRTest**. At the Command prompt, type "**ins**" and wait while the stage initializes (approximately 25 seconds). Restart **Operator**. Turn the green Power On/Off button off, wait 10 seconds. Press the Power On/Off button again to turn the power back on. Wait for the software to load. Open **RRTest**. At the Command prompt, type "**ins**" and wait while the stage initializes (approximately 25 seconds). Start **Operator**. If problem persists, contact Rudolph personnel. Contact Rudolph personnel.
18. System freezes with no wafer inside.		Turn the green Power On/Off button off, wait 10 seconds. Press the Power On/Off button again to turn the power back on. Wait for the software to load. Open **RRTest**. At the Command prompt, initialize the stage (**ins**), and initialize the robot (**inr**). Start **Operator**. If either the stage or the robot fails to initialize or if the laser does not return to mode-locked power, contact Rudolph personnel.

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Table C-1. *Meta*PULSE System Trouble Symptoms (Continued)

Symptoms	Possible Causes	Recommended Actions
19. System is shutdown with wafer on stage.		Open manual load door on the front of the tool. Slide the mini-environment top cover forward. Unload the wafer manually with a vacuum wand and return it to a cassette. Close the mini-environment top cover and the manual load door. If the wafer is too far to reach, close the mini-environment top cover and the manual load door. Open the wafer load door next to the robot, remove the wafer with a vacuum wand and return it to a cassette. Close the pulse door. **Note: The system will not function without all wafer doors closed.**
20. Programs are running very slowly.	Print screen key was depressed.	Double click the printer icon. Click on any pending print jobs. Right click on a selected print job and delete the print job. Repeat as necessary.
21. Cannot find a wafer report file.	Wrong **.log** file name selected.	Verify that you are using the correct filename for the desired wafer report.
	Wrong directory.	Change directory to **d:\rtiapps\data**.
	Report was not saved.	Open **Operator**. Select **Data** from the Menu bar. Open the report corresponding to the date and time that the desired cassette was run. Save the report file. Exit the wafer report screen. Cancel the Data view window.
	Report was not saved and/or has been overwritten.	Provide a system administrator with a copy of the raw data file for remodeling the data off-line.
22. Cannot find a raw data file.	Wrong **.mes** file selected.	Verify that you are using the correct filename for the raw data file.
	Wrong directory.	Verify that you are in the proper data directory and subdirectory.
	Data was never saved.	Remeasure the wafers.

Chiller Module

Use the information in the following table to troubleshoot possible problems with the Chiller Module of your *Meta*PULSE System. Locate the applicable symptom in the left column of the table to determine the recommended actions to rectify the problem.

Refer to the documentation shipped with the Chiller Module for additional information.

Table C-2. Chiller Module Trouble Symptoms

Symptoms	Recommended Actions
Chiller unit will not start	Ensure that the voltage of the power source meets the specified voltage of the Chiller (±10%). Refer to the serial number label on the rear of the unit to identify the specific electrical requirements of your unit. Check the High Temperature/Low Liquid Level Safety. If the FAULT light is on, make sure the fluid level in the bath is between the marks in the baffle and the HIGH TEMP/LOW LEVEL SAFETY setting is greater than the fluid temperature. Push the RESET switch(es) and attempt to restart. Ensure that the internal water screen is not clogged or blocked. Clean the screen as necessary. Attempt to restart the Chiller.
Loss of cooling capacity	Check the position of the REFRIGERATION switch. Settings should be Maximum Flowrate, Maximum Refrigeration, and a Setpoint of 25°C. When the unit is shut off, wait approximately five minutes before restarting. This allows time for the refrigeration pressures to equalize. If the pressures are not allowed to equalize, the compressor will short-cycle (clicking sound) and no cooling will occur. Proper ventilation is required for heat removal. Make sure ventilation through the front and rear panels is not impeded and the panels are free of dust and debris. Ice buildup on the cooling coils can act as insulation and lower the cooling capacity. Raise the temperature of the bath to de-ice the cooling coil and increase the concentration of non-freezing fluid. Ensure that the ambient temperature is within specifications (10 to 27°C [50 to 80°F]).
No external circulation	Check for obstructions, kinks, or leaks in the circulation tubing. Circulation will cease when the pump head has been exceeded.

Software Error Messages

Use the information in the following table to troubleshoot possible software problems with your *Meta*PULSE System. Locate the applicable error message in the left column of the table to determine probable causes and recommended actions to rectify the problem.

NOTE

The error listing provided here is not all inclusive. If you encounter an error that is not provided in this section, contact the Rudolph Service Department for information.

Table C-3. *Meta*PULSE System Software Error Messages

Err #	Error Message	Probable Causes	Recommended Actions
6	Alignment Matrix Not Calibrate: PC.	Align.dat file corrupted.	Contact Rudolph Technologies.
7	ALIGNMENT ERROR.	Unable to align optic head to wafer. - Dust on wafer. - Bad wafer. - Alignment matrix miscalibrated. - Height detector board failure. - Tilt detector board failure.	 Check wafer for problems. Contact Rudolph Technologies.
10	ILLEGAL CASSETTE SPECIFIED: PC.	Incorrect wafer cassette identifier specified.	Enter correct cassette identifier.
11	ILLEGAL WAFER SPECIFIED: PC.	Incorrect wafer location specified.	Enter correct wafer location.
13	BARCODE READ ERROR.	Barcode at location incorrect, unreadable, or missing.	Supply correct barcode.
17	A communication timeout has occurred between the PC and the BASE control board.	Communication cable not connected. PC serial port failure. Base control board hangup.	Check cables (most likely). Replace serial port. Reset *Meta*PULSE.
18	A communication timeout has occurred between the PC and the OPTIC control board.	Communication cable not connected. PC serial port failure. Base control board hangup. Optic control board hangup.	Check cables (most likely). Replace serial port. Reset *Meta*PULSE.
21	ALIGN.DAT FILE MISSING.	Align.dat file missing.	Recover an archived file and recalibrate alignment matrices.
22	ILLEGAL OPTICAL BIAS LEVEL.	Invalid optical bias selected.	Enter a valid optical bias.

Continued on next page

Table C-3. *Meta*PULSE System Software Error Messages (Continued)

Err #	Error Message	Probable Causes	Recommended Actions
23	EEPROMB.DAT FILE MISSING.	EEPROMB.DAT file missing.	Create file and enter command “upload base” or “upload_b” in RRTEST.
24	EEPROMO.DAT FILE MISSING.	EEPROMO.DAT file missing.	Create file and enter command “upload optic” or “upload_o” in RRTEST.
25	WAFER REPOSITION ERROR: PC.	Unable to center the wafer.	Make sure flat/notch setting is correct. Recalibrate flat/notch finder.
26	INVALID PASSWORD.	Incorrect password was given.	Provide correct password or contact system administrator.
28	Illegal Light Bulb Illumination. Valid Range (0-31)	Value entered that was outside the valid range.	Specify value that is within the specified range.
29	Base2 Control Board Not Installed.	Invalid *Meta*PULSE configuration.	Check *Meta*PULSE configured correctly in SETUP program.
30	A communication timeout has occurred between the PC and the BASE2 control board.	Communication cable not connected. Base2 control board hung up. PC serial port failure.	Check cables. Reboot *Meta*PULSE. Replace serial port.
31	EEPROMB2.DAT FILE MISSING.	EEPROMB2.DAT file missing.	Create file by entering command “upload base2” or “upload_base2” in RRTEST.
34	A communication timeout has occurred between the PC and the SMIF2 ARM.	Communication cable not connected. SMIF arm not connected.	Check cables. Attach SMIF arm.
38	EEPROMO.DAT File Is Corrupt.	Unknown.	Recreate file by typing “upload_o” in RRTEST.
39	EEPROMB.DAT File Is Corrupt.	Unknown.	Recreate file by typing “upload_b” in RRTEST.
40	EEPROMB2.DAT File Is Corrupt.	Unknown.	Recreate file by typing “upload_base2” in RRTEST.
41	ALIGN.DAT File Is Corrupt.	Unknown.	Restore file from backup copy.
42	EEPROMIF.DAT file missing. Please run RRTEST and upload eeprom values from interface control board.	First time installation.	Run RRTEST and type “upload intf”.

Continued on next page

Table C-3. *Meta*PULSE System Software Error Messages (Continued)

Err #	Error Message	Probable Causes	Recommended Actions
43	EEPROMIF.DAT file is corrupt.	Unknown.	Recreate EEPROMIF.DAT file by typing "upload intf" in RRTEST.
44	Interface Control Board Not Communicating with PC.	PC to Interface Control Board Cable not connected. Interface Control Board failure.	Check cables. Replace interface control board.
45	Wafer found on robot. Cannot initialize robot while wafer present. Please manually remove wafer from robot.	Wafer on robot arm when robot is initialized. On SMIF units, the robot cannot be initialized when wafer is on robot.	Manually remove wafer from robot.
110	The wafer FLAT was not found.	Failure to find flat on wafer.	Check wafer has a flat.
111	The wafer NOTCH was not found.	Failure to find notch on wafer.	Check wafer has a notch.
113	A wafer has been found on the robot.	Wafer unexpectedly found on robot.	Remove wafer from robot by unloading it into a cassette.
114	No Wafer is loaded on the stage.	Wafer not found on stage when a wafer unload is attempted.	Check vacuum system. Check wafer is on stage.
115	Illegal Cassette Destination.	Attempt to unload wafer to invalid cassette plate.	Retry command.
116	The wafer transfer cannot be performed because the two cassette sizes do not match.	Cassette sizes are different.	Place identical cassette sizes for wafer transfer.
117	Cassette Size Error. Check that the cassette is seated properly and that you are using the same cassette size specified in the recipe.	Cassette not found.	Place cassette.
122	SOURCE VACUUM ERROR.	Vacuum error.	Check vacuum system. Re-initialize unit.

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Table C-3. *Meta*PULSE System Software Error Messages (Continued)

Err #	Error Message	Probable Causes	Recommended Actions
123	A communication timeout has occurred between the BASE control board and the WAFER HANDLING unit.	Failure to communicate with wafer handler unit.	Check cables. Re-initialize unit.
124	The Wafer was Not Found in the Cassette Slot.	Wafer not found in cassette slot.	Check wafer present. Check vacuum system.
126	BARCODE was not correctly read.	Cannot read barcode on wafer.	Check wafer. Check barcode reader.
127	STAGE VACUUM ERROR.	Stage vacuum sensor failure.	Replace stage vacuum sensor.
128	ROBOT VACUUM ERROR.	Robot vacuum sensor failure.	Replace robot vacuum sensor.
129	Wafer Centering Failure.	Cannot center wafer.	Recalibrate flatnotch finding system. Verify flat or notch selected correctly.
583	Tilter failed to complete command.	Tilter (hardware) problem.	Initialize hardware.
584	Tilter out of position.	Tilter (hardware) problem.	Initialize hardware.
585	Tilters are not initialized.	Tilter (hardware) problem.	Initialize hardware.
586	Tilters are not present.	Configuration problem.	Check system configuration.
587	Station is not a pod.	Configuration problem.	Check system configuration.
588	Pod Loader communication failure.	Pod (hardware) problem.	Initialize hardware.
589	Pod is not initialized.	Pod (hardware) problem.	Initialize hardware.
633	Vectors are of different dimension.	Modeling error.	Check to ensure the correct wafer is being measured, or the cassette recipe is correct.
640	Matrix error.	Modeling error.	Check to ensure the correct wafer is being measured, or the cassette recipe is correct.
641	Matrix has invalid dimensions.	Modeling error.	Check to ensure the correct wafer is being measured, or the cassette recipe is correct.

Continued on next page

Table C-3. *Meta*PULSE System Software Error Messages (Continued)

Err #	Error Message	Probable Causes	Recommended Actions
642	Invalid row access for matrix.	Modeling error.	Check to ensure the correct wafer is being measured, or the cassette recipe is correct.
643	Invalid column access for matrix.	Modeling error.	Check to ensure the correct wafer is being measured, or the cassette recipe is correct.
644	Matrices with unequal dimensions.	Modeling error.	Check to ensure the correct wafer is being measured, or the cassette recipe is correct.
691	Vision Process called with wrong number of command line arguments.	Possible OS/2 or memory problems.	Exit from the program and reboot OS/2.
692	Vision Process unable to open shared data.	Possible OS/2 or memory problems.	Exit from the program and reboot OS/2.
693	Vision Process unable to open semaphores.	Possible OS/2 or memory problems.	Exit from the program and reboot OS/2.
694	Vision Process unable to set semaphores.	Possible OS/2 or memory problems.	Exit from the program and reboot OS/2.
695	Vision Process unable to close semaphores.	Possible OS/2 or memory problems.	Exit from the program and reboot OS/2.
696	Vision Process unable to clear semaphores	Possible OS/2 or memory problems.	Exit from the program and reboot OS/2.
697	Vision Process unable to find calibration file.	hicalib.par or localib.par is missing from d:\rtiapps\vision\setup.	Retrieve hicalib.par or localib.par from *Meta*PULSE vision install disk, then re-calibrate vision system.
698	Vision Process unable to find configuration file.	VSP.cnf is missing from d:\rtiapps\vision\setup.	Retrieve vsp.cnf from *Meta*PULSE vision install disk.
699	Vision Process unable to find number generation file.	Filenum.str is missing from d:\rtiapps\vision\setup.	Find out the largest pattern number in d:\rtiapps\vision\pat, then edit filenum.str, enter the number and save it.
700	Vision Process received invalid magnification.	Possible wrong vismain.exe.	Consult Rudolph Service Department to obtain the correct vismain.exe.
701	Poor vision pattern teach quality.	Poor features or improper threshold setup.	Select different site or re-adjust thresholds.
702	Not enough successful alignments to calibrate.	Poor feature site or repeat pattern site.	Select another site.

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Table C-3. *Meta*PULSE System Software Error Messages (Continued)

Err #	Error Message	Probable Causes	Recommended Actions
703	Vision Calibration Figure Of Merit too high.	Bad calibration site.	Select another site and re-calibrate.
704	Vision Teach unable to find enough patterns to qualify for alignment.	Poor teach site or hardware sync problem.	Select another site or check the hardware.
705	Vision Teach unable to write patterns.	No space on hard disk.	Check the hard disk space on D:\ drive.
714	Vision Search unable to read patterns.	Pattern is missing.	Check the pattern in d:\rtiapps\vision\pat directory.
715	Vision Search unable to find pattern alignment quality above threshold.	Color variation or pattern is outside FOV.	Contact Rudolph Service Department.
716	Vision Search coupling exceed Coupling Difference Threshold.	Possible repeat patterns or similar patterns in FOV.	Use restricted search.
719	Protect Device not installed in Imaging Technology Board.	EEPROM is missing on Imaging Tech Board.	Contact Rudolph Service Department.
720	Ill formed Vision System calibration matrix.	Incomplete localib.par or hicalib.par.	Check the files. Re-calibrate vision system if necessary.
721	Vision Process made call with parameter out of range.	Possible software bugs.	Contact Rudolph Service Department.
722	Vision Process unable to find any valid pattern.	Poor search image or pattern is outside FOV.	Contact Rudolph Service Department.
723	Vision Process unable to free shared data.	OS/2 API failure.	Shutdown OS/2 and reboot or consult with Rudolph Software Group.
724	Vision child process is not running, unable to register wafer.	Hardware security key is not installed.	Contact Rudolph Service Department to install the security key.
725	Vision Process unable to initialize vision board.	Communication failure between vision board and PC.	Re-plug in the board or replace the board.
726	Vision child process is unable to open pseudo serial port.	Communication failure between PC and Cognex board.	Check Cognex device driver is properly installed, board is properly plugged in and functions normally.

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Table C-3. *Meta*PULSE System Software Error Messages (Continued)

Err #	Error Message	Probable Causes	Recommended Actions
727	Vision child process is unable to close pseudo serial port.	Communication failure between PC and Cognex board.	Check Cognex device driver is properly installed, board is properly plugged in and functions normally.
728	Vision child process is unable to reset.	Communication failure between PC and Cognex board.	Check Cognex device driver is properly installed, board is properly plugged in and functions normally.
729	Vision child process is not in polling mode.	Cognex functions abnormally.	Check the board and run reset_vp.
740	Parent Vision Process unable to free shared data.	OS/2 API failure.	Shutdown OS/2 and reboot or consult with Rudolph Service Department.
741	Parent Vision Process unable to allocate shared data.	OS/2 API failure.	Shutdown OS/2 and reboot or consult with Rudolph Service Department.
742	Parent Vision Process unable to create semaphores.	OS/2 failure.	Contact Rudolph Service Department.
743	Parent Vision Process unable to set semaphores.	OS/2 failure.	Contact Rudolph Service Department.
744	Parent Vision Process unable to close semaphores.	OS/2 failure.	Contact Rudolph Service Department.
745	Parent Vision Process unable to clear semaphores.	OS/2 failure.	Contact Rudolph Service Department.
746	Call made to Child Vision Process after it ended.	Calls between *Meta*PULSE Apps and vismain are out of sync.	Exit the problem. Terminate vismain then restart.
747	Parent Vision Process unable to execute Child Vision Process.	The vismain could be still running.	Terminate vismain.
1100	Cassette Mapping - Wafer is Cross Slotted.	A wafer is cross slotted within the wafer cassette.	Remove the wafer from the cassette and place it within a slot correctly.
1101	Cassette Mapping - Wafer is Missing.	The selected wafer is missing from the wafer cassette.	Ensure the correct wafer was selected. Select the correct slot or place a wafer in the selected slot.

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Table C-3. *Meta*PULSE System Software Error Messages (Continued)

Err #	Error Message	Probable Causes	Recommended Actions
1102	Cassette Mapping - Wafer Exists in Destination/Reject Location.	The destination and/or reject cassette in the transfer differ from the source and a wafer is found in the corresponding cassettes slot.	Ensure the proper destination/ reject cassette was selected and that the correct wafer cassette was placed on the cassette plate.
1103	Cassette Mapping - No Wafer Selected for Measurement.	No wafer was selected for measurement.	Select a wafer for measurement.
1104	Wafer is off center.	The wafer is off center on the wafer positioning stage.	Remove the wafer from the stage and reload.
1105	Laser Power has drifted out of range.	The laser power has drifted out of the specification range.	Adjust knob on laser power supply to bring laser power within range specified in **d:\rtiapps\bin\syscalib.dat**. Contact Rudolph Service Department.

Contacting Rudolph Technologies

For additional information and support, contact Rudolph Technologies directly or through an authorized representative in your area. Contact information is provided in the following table.

Item	Information
Phone Number	(973) 691-1300
Fax Number	(973) 691-5480
Address	One Rudolph Road Flanders, NJ 07836

NOTE

Before contacting Rudolph Technologies, please obtain the Serial Number of your *Meta*PULSE System. This will help Rudolph Technologies personnel to expedite serving you.

The Serial Number is located on the front of the AC power chassis (lowest rack mount chassis behind the left door of the unit).

Serial Number

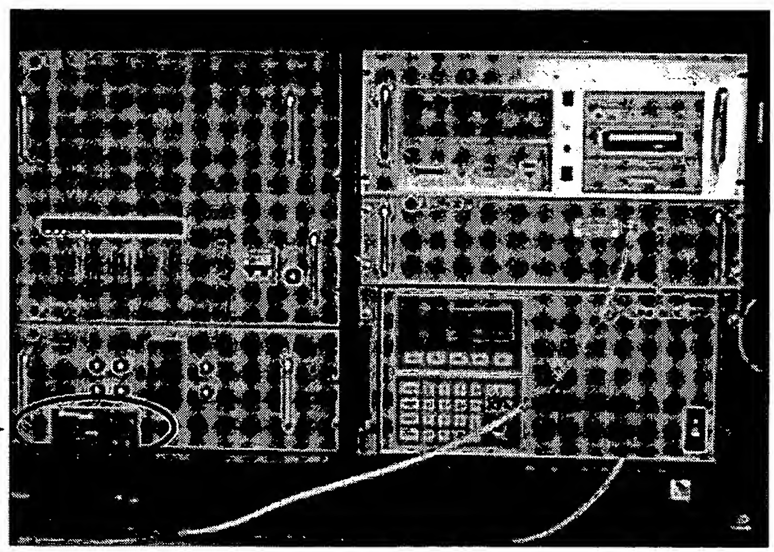

Figure C-1. Serial Number Location

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Preventive Maintenance

Appendix D

Introduction

This appendix provides you with information on how to perform basic preventive maintenance tasks.

The topics covered in this appendix include:

Safety Considerations

Read and understand the following important safety considerations prior to performing any preventive maintenance or repairs on the *Meta*PULSE System, Chiller Module, or any system support equipment.

NOTE

Component replacement, repairs, optical alignment, and system calibration should not be attempted without first contacting Rudolph Technologies.

Laser Safety

*Meta*PULSE Systems meet or exceed all requirements of U.S. Federal Regulation 21CFR1040.00 for a Class I laser product when all doors and access panels to the Measurement Module are closed. No special measures are required to protect the operator from laser radiation under normal operating conditions.

In certain maintenance modes, service personnel may have access to a Class IV laser product and will need appropriate protective materials. Laser warning labels (shown below) are affixed at several locations on the *Meta*PULSE System:

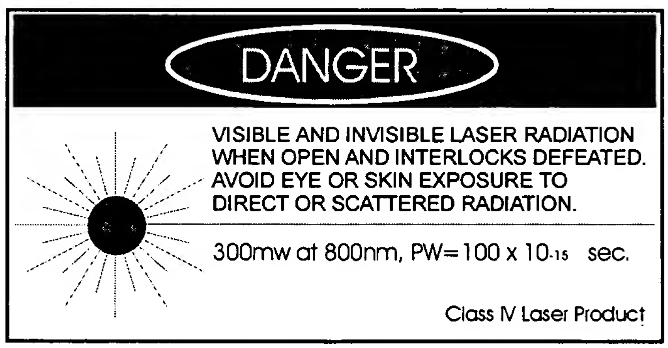


Figure D-1. Laser Safety Label

Electrical Safety

All equipment must be reduced to the lowest level electrical hazard as possible for all work being performed, and should be locked and tagged out when possible for all electrical work.

WARNING

Potentially hazardous voltages may be present in the *Meta*PULSE System, Chiller Module, and any system support equipment. Failure to follow proper safety precautions may result in serious personal injury or death. Electrical problems should be referred to qualified electricians or Rudolph Technologies support personnel.

Emergency Procedures

Prior to starting any work, service personnel should locate the nearest emergency equipment and information including, but not limited to, the following:

- Eyewash Station
- Showers
- Fire Extinguishers
- Emergency Telephone Numbers/Contact Information
- Emergency Exits

It is the responsibility of the service personnel to be familiar with emergency procedures specific to the location at which preventive maintenance and/or repairs are being performed.

Support Equipment

The following table lists the equipment and consumable items that are necessary to maintain and service the *Meta*PULSE System.

Table D-1. Maintenance Equipment and Consumable Items

Item	Needed for ...
Deionized or Distilled Water	Refilling Chiller Module
Jaz™ Disk(s)	Backup Procedures
Clean Room Approved Cleaner	System Cleaning
Clean Room Wipes	System Cleaning

Maintenance Procedures

The sections that follow provide procedures for performing preventive maintenance on your *Meta*PULSE System and Chiller Module.

Table D-2 lists the maintenance tasks, the recommended minimum frequency with which the tasks should be performed, and conditions which may require the maintenance tasks to be performed prior to their regularly scheduled time.

Table D-2. Preventive Maintenance Schedule

Maintenance Task	Recommended Frequency	Also Perform When ...	Page
Record and adjust Laser Base Plate Temperature	As needed.	--	AD D–8
Top Off Chiller Module with Deionized or Distilled Water	As needed.	--	AD D–9
System Cleaning (Wipe down Robot Probe, Stage, and Cabinet, clean Bay and Chase Areas)	As needed.	--	AD D–11
Check Vacuum Levels*	Semi-Annually	After a system failure or questionable measurements	--
Check Robot and Cassette Plate Calibration*	Semi-Annually	After a system failure or questionable measurements	--
Lubricate Delay Stage Components*	Semi-Annually	--	--

* Procedure to be performed by Rudolph trained and certified service personnel only. The procedures for performing these maintenance tasks are beyond the scope of this manual.

In addition to the maintenance tasks described in Table D-2, certain database operations (such as backup and cleanup) should also be performed on a regular basis. Table D-3 lists the database operations and the recommended frequency with which the tasks should be performed.

Table D-3. Recommended Intervals for Database Operations

Maintenance Task	Recommended Frequency	Also Perform When ...	Page
Backup Recipe Database	Weekly	User determined. Based on frequency of Recipe creation.	AD D–12
Backup Map Files	Weekly	User determined. Based on size of Map file database.	AD D–13
Backup and Delete Log0 File	Quarterly	--	AD D–16
Backup Configuration Files	--	On installation and after calibration.	AD D–16
Purge Vision Files	Quarterly	--	AD D–19
Backup OS/2 Desktop	--	Any time changes are made that affect the desktop.	AD D–20

Before You Begin

Before performing any preventive maintenance task on the *Meta*PULSE System and Chiller Module, you must:

- Read and understand these instructions
- Be certified to perform the task or be directly supervised by a certified trainer

CAUTION

Improper performance of the preventive maintenance procedures by untrained or uncertified personnel may result in damage to the *Meta*PULSE System.

Use the following guidelines prior to starting any preventive maintenance task:

1. Review the maintenance procedure and ensure that all needed parts and tools are available.
2. Obtain any additional material required by the maintenance task.
3. Inform area users that the *Meta*PULSE system will be down.

Returning the System to Production Mode

After the successful completion of all preventive maintenance tasks, you may return the equipment to normal production mode.

Refer to Appendix A, "Starting and Stopping the System" for the appropriate procedure.

Maintenance Procedures

This section contains information for following tasks:

- Record and adjust the Laser Base Plate temperature
- Refill the Chiller Module with deionized or distilled water
- Perform System Cleaning
  - Wipe down the system external surfaces
  - Clean the Bay and Chase areas around the system
- Back up recipe database and map files

Materials Required

- Deionized or Distilled Water
- Clean Room Approved Wipes
- Clean Room Approved Cleaner
- 3.5" formatted floppy disks or formatted Jaz disks

Record and Adjust Laser Base Plate Temperature

The Laser Base Plate temperature should be maintained at 24.0 ± 1°C (75°F).

1. Check the Laser Base Plate temperature on the Laser Power Supply LED screen.
2. If the temperature is not within specifications, adjust the temperature controls on the Chiller Module as necessary.

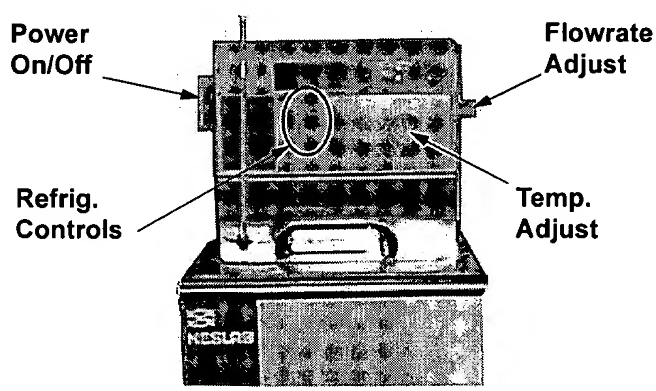


Figure D-2. Chiller Module Controls

Top-off Chiller Module with Deionized or Distilled Water

The water reservoir inside the Chiller Module has markers (1 inch horizontal slits located in the center of the stainless steel baffle that separates the work area from the pump assembly) that indicate the high and low water levels. Figure D-3 shows the water markers inside the water reservoir.

Maintain the fluid level between the two markers by topping off with deionized or distilled water as needed.

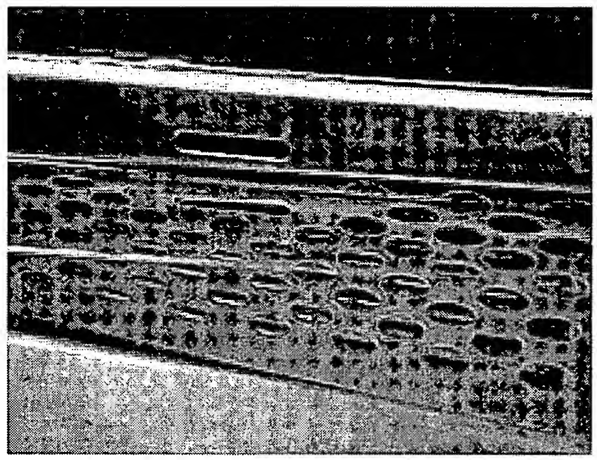


Figure D-3. Chiller Module — Water Level Markers

CAUTION

The heating and cooling coils will be exposed and may become damaged if the correct fluid level is not maintained.

Never run the Chiller Module when the bath work area is empty.

1. Remove the top cover (see Figure D-4) of the Chiller Module.

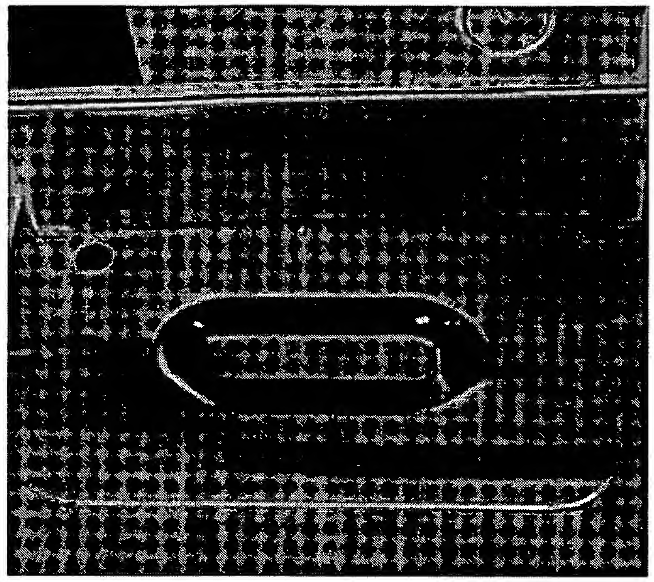


Figure D-4. Chiller Module — Top Cover

2. Top off the water level with deionized or distilled water until the level is equal to the high water limit (see Figure D-3).

CAUTION

Do not exceed the high water limit.

3. Place the reservoir cover back on the Chiller Module.

Clean the System

Use the following procedures to clean the System and the area around the System.

Wipe Down External Surfaces

Wipe down the external surfaces of the System using the following procedure:

1. Spray a cleanroom wipe with a cleanroom approved cleaner (or use pre-saturated wipes as applicable).
2. GENTLY clean the surface of the robot probe by dragging the cleanwipe over the probe surface.

CAUTION

DO NOT use excessive force when wiping the robot probe. Bending the probe can cause irreparable damage which will require replacing the probe.

3. Use additional cleanroom wipes (pre-saturated or sprayed with cleanroom approved cleaner) to clean the system cabinet.

Clean Bay and Chase Areas

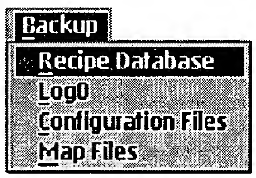
Clean the Bay and Chase areas around the System. Discard any old printouts.

Back Up the Recipe Database

Use the following procedure to back up *Meta*PULSE wafer recipe database and Vision Pattern database:

1. If it is not already running, start the *Meta*PULSE System **Setup** program using the procedure given in "Starting the Setup Program" on page AD A–10.

   The Setup main window is displayed.



2. Select **Backup** from the Setup Main menu, then select **Recipe Database** when the Backup menu is displayed.

   A Recipe Database Backup message is displayed informing you that the Measurement, Modeling, and SECS-II applications must be shut down prior to performing the backup, and asking you if you wish to continue.

3. Perform **one** of the following:

   - **If you do not wish to continue:** click on **[No]**.

     You are returned to the Setup Main window.

   - **If you wish to continue:** click on **[Yes]**.

     A message is displayed asking if you wish to backup to drive A:\.

NOTE

If you are backing up to floppy, the number of floppy disks required to backup the database will vary. It is recommended that you have at least 10 blank, formatted, floppy disks available for the backup.

4. Perform **one** of the following:

   - **To backup to a floppy disk:** click on **[Yes]**.

     A window is displayed indicating that the database files are being compressed. When the compression has been completed a window is displayed indicating the number of floppy disks the backup will require. Continue with Step 5.

   - **To backup to a path other than the floppy disk:** click on **[No]**.

     A window is displayed in which you may enter the desired backup path. Enter the full path name of the desired backup directory (such as, G:\BACKUP\) and click on **[Enter]**. A window is displayed indicating that the selected database files are being written to the backup path. Proceed to Step 7.

5. Click on **[OK]**.

   A window is displayed instructing you to insert a blank, formatted floppy disk in drive A:\.

6. Insert a blank, formatted floppy disk in drive A:\ and click on **[OK]**.

   A window is displayed indicating that the selected database files are being written to the disk. You will be prompted to insert each additional floppy disk that is required to complete the backup.

7. When all files have been written to the selected backup path, a window will be displayed indicating that the backup is complete. Click on **[OK]**.

   You are returned to the Setup main window.

Back Up Map Files

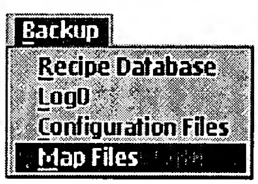
NOTE

Depending upon your system configuration, the Map Files Backup option may not be available.

Use the following procedure to back up *Meta*PULSE wafer map files:

1. If it is not already running, start the *Meta*PULSE System **Setup** program using the procedure given in "Starting the Setup Program" on page AD A–10.

   The Setup main window is displayed.



2. Select **Backup** from the Setup Main menu, then select **Map Files** when the Backup menu is displayed.

   A message is displayed asking if you wish to backup to drive A:\.

NOTE

If you are backing up to floppy, the number of floppy disks required to backup the database will vary. It is recommended that you have at least 10 blank, formatted, floppy disks available for the backup.

3. Perform **one** of the following:

   - **To backup to a floppy disk:** click on **[Yes]**.

     A window is displayed indicating that the database files are being compressed. When the compression has been completed a window is displayed indicating the number of floppy disks the backup will require. Continue with <u>Step 4</u>.

   - **To backup to a path other than the floppy disk:** click on **[No]**.

     A window is displayed in which you may enter the desired backup path. Enter the full path name of the desired backup directory (such as, G:\BACKUP\) and click on **[Enter]**. A window is displayed indicating that the selected database files are being written to the backup path. Proceed to <u>Step 6</u>.

4. Click on **[OK]**.

   A window is displayed instructing you to insert a blank, formatted floppy disk in drive A:\.

5. Insert a blank, formatted floppy disk in drive A:\ and click on **[OK]**.

   A window is displayed indicating that the selected database files are being written to the disk. You will be prompted to insert each additional floppy disk that is required to complete the backup.

6. When all files have been written to the selected backup path, a window will be displayed indicating that the backup is complete. Click on **[OK]**.

   You are returned to the Setup main window.

Database Operations

In order to protect against the possible loss of database information, the *Meta*PULSE System **Setup** program provides the capability to perform the following database operations:

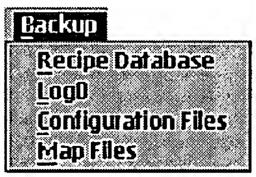
- Backup and restore
  - Wafer recipe database
  - Vision System pattern database
  - The log0 history file
  - Configuration files
  - Wafer map files
- Purge Vision database of unrelated image files

In addition to the database operations that may be performed with the Setup program, the *Meta*PULSE System software comes with a utility that allows you to backup and restore the OS/2 desktop.

NOTE

For procedures for backing up the wafer recipe database and map files, refer to "Back Up the Recipe Database" on page AD D–12 and/or "Back Up Map Files" on page AD D–13.

Back Up the Configuration and Log0 Files



Use the following procedure to back up *Meta*PULSE System files:

1. If it is not already running, start the *Meta*PULSE System **Setup** program using the procedure given in "Starting the Setup Program" on page AD A–10.

   The Setup main window is displayed.

2. Select **Backup** from the Setup Main menu.

   The Backup menu is displayed.

3. Select **one** of the following options from the Backup menu:

   - **Log0** — Backs up the log0 history file.
   - **Configuration Files** — Backs up the configuration files.

   A message is displayed asking if you wish to backup to drive A:\.

   NOTE

   If you are backing up to floppy, the number of floppy disks required to backup the database will vary. It is recommended that you have at least 10 blank, formatted, floppy disks available for the backup.

4. Perform **one** of the following:

   - **To backup to a floppy disk:** click on **[Yes]**.

     A window is displayed indicating that the database files are being compressed. When the compression has been completed a window is displayed indicating the number of floppy disks the backup will require. Continue with Step 5.

   - **To backup to a path other than the floppy disk:** click on **[No]**.

     A window is displayed in which you may enter the desired backup path. Enter the full path name of the desired backup directory (such as, G:\BACKUP\) and click on **[Enter]**. A window is displayed indicating that the selected database files are being written to the backup path. Proceed to Step 7.

5. Click on **[OK]**.

   A window is displayed instructing you to insert a blank, formatted floppy disk in drive A:\.

6. Insert a blank, formatted floppy disk in drive A:\ and click on **[OK]**.

   A window is displayed indicating that the selected database files are being written to the disk. You will be prompted to insert each additional floppy disk that is required to complete the backup.

7. When all files have been written to the selected backup path, a window will be displayed indicating that the backup is complete. Click on **[OK]**.

   One of the following will occur:

   - **If you selected "Configuration Files" from the Backup menu:** you are returned to the Setup main window.

   - **If you selected "Log0" from the Backup menu:** a window is displayed asking if you wish to delete the current Log0 file. To delete the Log0 file, click on **[Yes]**. Click on **[No]** to retain the current Log0 file. You are then returned to the Setup main window.

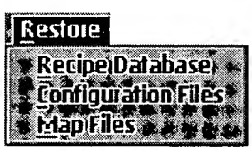
8. Repeat this procedure as necessary to back up other system files.

Restoring the Database

Use the following procedure to restore *Meta*PULSE System files:

1. If it is not already running, start the *Meta*PULSE System Setup program using the procedure given in "Starting the Setup Program" on page AD A–10.

   The Setup main window is displayed.



2. Select **Restore** from the Setup Main menu.

   The Restore menu is displayed.

3. Select **one** of the following options from the Restore menu:

   - **Recipe Database** — Restores the Wafer Recipe database and the Vision System pattern database.

     A Recipe Database Restore message is displayed informing you that the Measurement, Modeling, and SECS-II applications must be shut down prior to performing the restore, and asking you if you wish to continue. If you wish to continue, click on **[Yes]**. Click on **[No]** to abort the restore.

   - **Configuration Files** — Restores the configuration files.

   - **Map Files** — Restores the wafer map files.

   A window is displayed warning you that the existing files on the *Meta*PULSE System will be overwritten.

4. Perform **one** of the following:

   - **To continue with the restore and overwrite the existing files:** click on **[OK]**.

     A window is displayed asking if you wish to restore from drive A:\. Continue with Step 5.

   - **To abort the restore:** click on **[Cancel]**.

     You are returned to the Setup main window. The procedure is complete.

5. Perform **one** of the following:

   - **To restore from a floppy disk:** click on **[Yes]**.

     A window is displayed in which you must enter the number of floppy disks that make up the backup set for the selected files. Continue with Step 6.

   - **To restore from a path other than the floppy drive:** click on **[No]**.

     A window is displayed in which you may enter the source path for the restore files. Enter the full path name of the desired directory (such as, G:\BACKUP\) and click on **[Enter]**. A window is displayed indicating that the files are being copied from the restore path. Proceed to Step 8.

6. Enter the number of floppy disks that make up the backup set and click on **[Enter]**.

7. Insert the first backup disk in drive A:\ and click on **[OK]**.

   A window is displayed indicating that the files are being copied from the floppy disk. You will be prompted to insert each additional floppy disk that is required to complete the restore.

8. When all files have been copied from the selected restore path, a window will be displayed indicating that the restore is complete. Click on **[OK]**.

   You are returned to the Setup main window.

Deleting Vision System Files

The image files that are left behind when associated pattern recognition recipes are deleted may be removed from the database.

Use the following procedure to delete the vision system files:

1. If it is not already running, start the *Meta*PULSE System Setup program using the procedure given in "Starting the Setup Program" on page AD A–10.

   The Setup main window is displayed.

2. Select **Database** from the Setup Main menu, then select **Vision** when the Database menu is displayed.

   The Vision Database Maintenance window is displayed as shown in Figure D-5. This window will show all of the image files in the database that are no longer associated with a recipe.

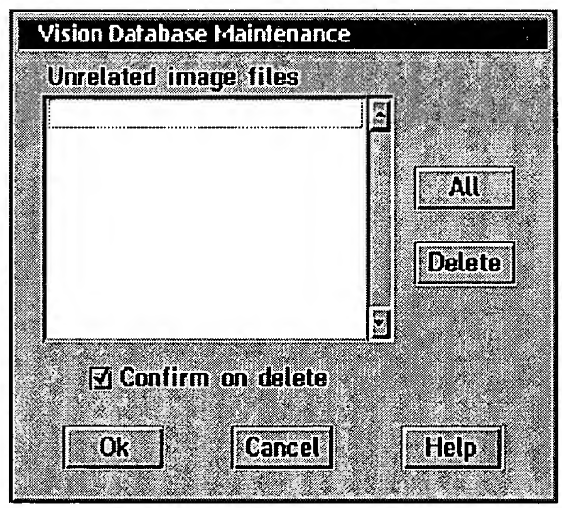


Figure D-5. Vision Database Maintenance Window

3. Select the image file(s) to be deleted by clicking on the desired name(s) in the list, or click on **[ALL]** to select all of the image files.

4. If you want the system to prompt you to confirm the deletion of each individual file, click on the **[Confirm on delete]** button so that a checkmark appears. No checkmark indicates the system will not prompt prior to deleting the selected files.

5. Click on **[Delete]** to delete the selected image files.

6. When the files have been deleted, click on **[Ok]** in the Vision Database Maintenance.

   You are returned to the Setup main window.

Backing Up the OS/2 Desktop

Use the following procedure to back up the OS/2 desktop (folders, icons, and other objects included on the OS/2 desktop):

1. Open an OS/2 command prompt (either OS/2 window or full screen).
2. Change directory to **D:\RTIAPPS\DESKBACK**.
3. Enter the following command at the OS/2 prompt then press the **[Enter]** key on the keyboard:

   SYSBACK

   The desktop files are backed up in a zip file that is saved in the D:\RTIAPPS\DESKBACK directory. Each time the backup is performed the new zip file is created, renaming the previously backed up zip files.

Restoring the OS/2 Desktop

Use the following procedure to restore the OS/2 desktop (folders, icons, and other objects included on the OS/2 desktop):

1. Reboot the computer, when the white box in the upper left corner of the screen appears, press **Alt + F1**.

   The Recovery Choices screen is displayed.

2. Select **Go To Command Line**.
3. Change directory to **D:\RTIAPPS\DESKBACK**.
4. Perform **one** of the following:
   - **To restore from the most recent desktop backup:** go to Step 5.
   - **To restore from an older desktop backup:** rename the desired backup file to **SYSBCK01.ZIP**. Go to Step 5.
5. Enter the following command at the OS/2 prompt then press the **[Enter]** key on the keyboard:

   SYSRESTR

   The OS/2 desktop is restored.

6. Reboot the computer.

Other Maintenance Procedures

The following tasks should be performed on an "as needed" basis:

- Clean Chiller Module grille and condenser

Materials Required

- Vacuum Cleaner

Clean the Chiller Module Grille and Condenser

Clean the Chiller Module grille and condenser using the following procedure:

NOTE

The frequency of cleaning the Chiller Module grille and condenser will vary depending upon the operating environment.

1. Visually inspect the grille and condenser. If cleaning is required, proceed with the next step.

WARNING

To reduce the risk of electrical shock, turn off the Chiller Module and disconnect the main power cord before removing the front panel.

2. Turn off the Chiller Module and disconnect the main power cord.
3. Grasp the grille assembly on the front of the Chiller Module and pull forward to remove.
4. Vacuum the grille assembly and the condenser.
5. Replace the grille assembly.
6. Connect the main power cord and turn on the Chiller Module.

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Glossary

A | B | C | D | E | F | G | H | I | J | K | L | M | N | O | P | Q | R | S | T | U | V | W | X | Y | Z

— A —

Action Bar
Located near the bottom right portion of the screen in certain operating modes, the buttons available on the Action Bar allow for the control of the current process (e.g. start, stop, skip, and/or abort measurements), or allow for quick access to certain control functions (e.g. view, map, graph, print, and/or export data).

Administrator
Individual(s) responsible for configuring system hardware and software, setting up system user logins, passwords, and groups, and performing other administrative tasks (such as database backup).

Analysis
The data reduction routines applied to the measurements.

Application
A film measurement requirement.

— B —

Barcode Reader
A device used to scan the identification code on the bottom of each wafer.

Batch
A numbered group of wafers.

— C —

Calibration Program
Used by Rudolph personnel to calibrate the *Meta*PULSE System.

Cassette
A container for transporting and storing wafers. Also referred to as a Wafer Cassette.

Cassette Plate
The plate on which a wafer cassette is placed. Cassette plates contain sensors to automatically determine the size of a cassette that has been placed upon it. *Meta*PULSE 200 Series Systems are configured with two cassette plates or SMIF Loaders. *Meta*PULSE 300 Series Systems may have two cassette plates, or one or both of the cassette plates may be replaced by a Front Opening Unified Pod (FOUP). For the purposes of this guide, the term Load Port is used to refer to any of these configurations.

Cassette Recipe
The instructions for performing measurements on a cassette. Each Cassette Recipe consists of one or more wafer recipes, a transfer specification, and a control specification.

Chip
One integrated circuit on the wafer. Also referred to as a Die. In this guide, "Chip" and "Die" are used interchangeably.

Control Specification
Part of a Cassette Recipe. The Control Specification specifies which parameters (if any) will be deferred to the Operator at run time, how wafer IDs will be generated, how long measurement data will be retained in the measurement database, and the number of times the Cassette Recipe will repeat.

— D —

Data Combination
A function of Data Review Mode which allows difference, removal rate, and averaging operations to be performed on selected measurement data.

Data Review Mode
Functional mode of the *Meta*PULSE Operator program which allows a Process Engineer to retrieve, view, and print measurement data, and to create wafer maps and graphs, and to perform data combination tasks.

A | B | C | D | E | F | G | H | I | J | K | L | M | N | O | P | Q | R | S | T | U | V | W | X | Y | Z

Database
Information stored in a structured, easily retrievable fashion. Consists of the measurement data, calculated parameters, wafer data, wafer materials, and recipe information.

Die
The region on a wafer that defines one integrated circuit (chip).

Dynamic Repeatability
A test to determine the measurement variation of the instrument when measuring the same point on a wafer multiple times, and includes the variations introduced by the mechanical movements of the sample stage.

— E —

Electronics Bay
The lower portion of the measurement mini-environment/module located below the computer keyboard. Contains the system computer, utility connections, and control electronics.

Engineer
See Process Engineer.

— F —

Filmstack (Film Stack)
A template used to represent the materials and parameters expected in the film structure of a particular site on a wafer. Filmstacks are required to model the measured data and produce calculated results.

Flat / Notch Finder (Detector)
A sensing system used to determine centering and radial position of the wafer on the vacuum chuck.

Folder
A grouping of subfolders in the recipe database. Similar to a directory on a computer disk.

— G —

Generated data
The calculated parameters and results of any statistical operations.

Group
See User Group.

— H —

History Log
Log file containing the data from past measurement runs. The number of measurement logs maintained in the history file is configured by the Administrator.

Host
An external computer system that can be used to control the *Meta*PULSE System via an optional SECS-II interface.

— I —

Interlayer
Algorithm or factor used to compensate for interface effects in multi-layer materials, reducing fit errors and improving order resolution in certain applications.

— L —

Load Port
A *Meta*PULSE 300 System can be configured with cassette plates for open wafer cassettes, or optional Front Opening Unified Pods (FOUPs). A *Meta*PULSE 200 System can be configured with cassette plates for open wafer cassettes, or optional SMIF Loaders. "Load Port" refers to any of these configurations. For the purposes of this guide, the terms "load port" and "cassette plate" are used interchangeably.

Login
A username/password combination that allows the user to access certain functions or perform certain tasks depending upon the privilege levels granted to their user record and the system security configuration.

The term "login" also refers to the act of entering the username/password combination.

A | B | C | D | E | F | G | H | I | J | K | L | M | N | O | P | Q | R | S | T | U | V | W | X | Y | Z

— M —

Mapping
A function of Data Review Mode, this allows wafer maps to be created, viewed, and/or edited. Maps may be contour (2D) or topographic (3D).

Material
The physical composition of a film or substrate (e.g., AlCu, Si, TiN, etc.)

Measurement Mini-Environment/Module
The portion of the *Meta*PULSE System which houses the measurement system, wafer positioning stage, and in the case of closed-pod systems, the wafer handling robot. This portion of the system has specially purified low particulate air flow.

Measurement Database
Contains the measurement data for processes that have been run. The measurement data is then accessed and viewed and/or manipulated with the Operator program in Data Review Mode.

Menu Bar
Located near the top of the screen, the menu bar displays the items or commands that can be selected or activated in the current window. Items that are unavailable are ghosted and cannot be selected.

Microscope
Used to provide magnified views of the wafer in the Site Locator (Live Video) window.

Monitor Wafer
An unpatterned wafer.

— O —

Operator
Individual(s) responsible for placing wafers on and removing wafers from the system, selecting the applicable Cassette Recipe, and starting the measurement run.

Operator Program
An integrated, multi-functional, graphical user interface (GUI). The three main operating modes of the Operator program allow you to create filmstacks and recipes (Recipe Creation Mode), select and run recipes to perform wafer measurements (Run Mode), and to retrieve the measurement data (Data Review Mode).

Owner
Individual(s) who are responsible for (own) items stored in the recipe database (e.g. folders, subfolders, cassette recipes, wafer recipes, materials, etc.) Owners determine the security permission levels for their items and grant or deny access to the item on a user group basis.

— P —

Patterned Wafer
A wafer having integrated circuits or precursor etched patterns on its surface.

Process Engineer
Individual(s) responsible for creating and modifying the filmstacks and wafer recipes that are then combined with transfer and control specifications to make up a Cassette Recipe. Additional functions include retrieval and manipulation of measurement data, and the creation/modification of templates to be used in filmstacks and wafer recipes.

— R —

Recipe
See Wafer Recipe.

Recipe Creation Mode
Functional mode of the *Meta*PULSE Operator program which allows a Process Engineer to create, test, and/or modify filmstacks, wafer recipes, and templates.

Recipe Database
Contains the templates, materials, filmstacks, and recipe information used to perform wafer measurements.

Registration
Used for patterned wafers to accurately determine chip size and wafer position (deskew).

Repeatability
Statistical spread of repeated measurements.

Report
See Wafer Report.

Robot Arm
Electro-mechanical device used to transport wafers to and from wafer cassettes/pod loaders and the wafer positioning stage.

Robot Mini-Environment/Module
The portion of the *Meta*PULSE System which houses the wafer handling robot arm, cassette plates, load ports, and control electronics. In the case of closed-pod systems, this portion of the system has specially purified low particulate air flow.

Rudolph Standard
Default database object or system application provided with the system by Rudolph Technologies.

Run Mode
Functional mode of the *Meta*PULSE Operator program which allows an Operator to select a cassette recipe in order to perform measurements on wafers.

— S —

SECS Interface
Optional hardware package that allows the *Meta*PULSE System to be remotely controlled by a host computer via a SECS-I (RS-232C) or HSMS (TCP/IP) connection.

SECS-II Program
Program used to configure and control the optional SECS-II interface.

Setup Program
Program used to configure and customize the *Meta*PULSE System. With this program, the Administrator sets system default values, configures system security features, and performs certain database related tasks (backup and restore).

Static Repeatability
A test to determine the measurement variation of the instrument when measuring the same point on a wafer several times, and does NOT include the variations introduced by the mechanical movements of the sample stage.

Status Bar
Located at the bottom of the screen, the status bar provides pointer help, an indication of the current system status (ready, running process, etc), the SECS-II communications status (online/offline, local/remote), the login name of the individual currently logged in, and the current system time.

Stepper Group
The chips contained within one exposure of the stepper. Normally each stepper group on a wafer is identical although the chips within the stepper groups may not be.

Subfolder
Contained within a folder, a subfolder is a grouping of cassette recipes in the recipe database. Similar to a subdirectory on a computer disk.

— T —

Template
Used as building blocks for wafer recipes. Consists of a data component (i.e., filmstack, transfer specification, and wafer report), containing a unique data configuration.

Title Bar
Located at the top of the screen, the title bar provides an indication of the version of the *Meta*PULSE Operator program that is running, as well as the current mode of operation.

Tool Bar
Located near the top of the screen, the tool bar consists of buttons that allow for quick access to certain system functions (such as changing the mode of operation, logging in and out, and controlling a measurement run).

A | B | C | D | E | F | G | H | I | J | K | L | M | N | O | P | Q | R | S | T | U | V | W | X | Y | Z

Transfer Specification
Template used to identify the source and destination cassette locations, the cassette slots containing the wafers to be measured, cassette mapping functions, and the cassette to which wafers will be returned if measurements are rejected.

— U —

Unpatterned Wafer
A template used to specify the measurement pattern for unpatterned wafers. Recipe made for monitor wafer applications.

User Group
A grouping of user records. Each user belongs to one or more group. Security permission levels are assigned to each group, these permissions are then transferred to each member of the group.

User Interface
The station from which the *Meta*PULSE System is controlled. Consists of the power controls, video display, keyboard, and pointing device.

User Record
The profile for an individual user. Consists of the user name, password, basic privileges allowed (access to certain operating modes, creation of recipe items, shutting down the Operator program, and deleting recipe items), and a list of the user groups of which the user is a member.

— W —

Wafer Cassette
See Cassette.

Wafer Recipe
A set of instructions to describe the measurement of a wafer.

Wafer Report
A template used to control the output format of the measured data.

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RUDOLPH
Technologies, Inc.

***Meta*PULSE**
Administrator's Guide

Part Number: A17945 Rev. A
Issue Date: September 4, 1998

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Accuracy	❑	❑	❑	❑
Organization	❑	❑	❑	❑
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